

CT SYSTEMS, INC.
INSTRUCTION MANUAL
MODEL 1402A
SWEEP GENERATOR



WARRANTY

CT SYSTEMS, INC.

INSTRUCTION MANUAL

MODEL 1402A

SWEEP GENERATOR

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CONTENTS

SECTION 1 – GENERAL INFORMATION

- 1.1 INTRODUCTION
- 1.2 SPECIFICATIONS
- 1.3 OPTIONS
- 1.4 ACCESSORIES

SECTION 2 – OPERATING INSTRUCTIONS

- 2.1 INTRODUCTION
- 2.2 MECHANICAL INSTALLATION
- 2.3 ELECTRICAL INSTALLATION
- 2.4 DESCRIPTION OF FRONT PANEL
- 2.5 DESCRIPTION OF REAR PANEL
- 2.6 TYPICAL OPERATING SET-UP
- 2.7 SPECIAL OPERATING NOTES
- 2.8 PROGRAMMING

SECTION 3 – CIRCUIT DESCRIPTION

- 3.1 INTRODUCTION
- 3.2 SIMPLIFIED BLOCK DIAGRAM
- 3.3 POWER SUPPLY (PS7)
- 3.4 CHANNEL PROGRAM SWITCH
- 3.5 SWEEP DRIVE (MODULE M2E-1)
- 3.6 SWEEP OSCILLATOR (MODULE M9L)
- 3.7 OUTPUT AMPLIFIER (MODULE M10GA)
- 3.8 CRYSTAL SOURCE (MODULE M3E-1)
- 3.9 CRYSTAL SOURCE (MODULE M3E-2)
- 3.10 CARRIER MARKERS (MODULE M4E-2)
- 3.11 IF MARKERS (OPTION A-71)
- 3.12 IF CONVERSION L.O. TRACKING (OPTION B)
- 3.13 AUTOMATIC LEVEL AND SCOPE INDICATORS (OPTION C)

SECTION 4 –MAINTENANCE

- 4.1 INTRODUCTION
- 4.2 SERVICE INFORMATION
- 4.3 PERFORMANCE CHECKS
- 4.4 CALIBRATION PROCEDURE
- 4.5 TROUBLESHOOTING

SECTION 5 – REPLACEABLE PARTS

- 5.1 INTRODUCTION
- 5.2 MANUFACTURERS CODE
- *** PARTS LISTS

SECTION 6 – SCHEMATICS

- 6.1 INTRODUCTION
- 6.2 SCHEMATIC NOTES
- 6.3 ABBREVIATION CODE
- 6.4 SCHEMATIC INDEX
- *** SCHEMATICS

CHANGE INFORMATION, IF ANY, IS LOCATED AT THE REAR OF THIS MANUAL



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SECTION 1

GENERAL INFORMATION

1.1 INTRODUCTION

The Wavetek Model 1402A is an all-solid-state electronically swept and tuned VHF Sweep/Marker Generator covering the 40 to 400 MHz range. Center frequency and markers are controlled by a 36-channel switch providing audio and video carrier markers at IF, VHF TV channels 2 through 13, and CATV channels A through W. It is designed for the testing and aligning of VHF television tuners and receivers and of CATV converters and "head-end" equipment.

The RF marker system is unique in that it provides 72 IF and RF carrier markers, while using only 12 crystals. The markers consist of sharp positive-going or negative-going pulses, sufficient in amplitude for oscilloscope intensity modulation (available at a rear-panel connector), and/or negative differentiated pulses internally added to the demodulated envelope.

An important feature of the Model 1402A is its ability to be remotely controlled and programmed. This enables the sweep generator to be sequenced through the test procedure with pushbutton switches instead of manual tuning and adjustment. Also, the channel switch assembly can be quickly disconnected so that it may be removed from the instrument, extended, and remotely located at the tuner or receiver test fixture.

The Model 1402A's most outstanding option is that of automatic level operation. Simply stated, in automatic level operation the sweep generator RF output level is automatically adjusted to follow the variations of the tuner or

receiver to maintain a constant one volt pattern on the oscilloscope display. A baseline pedestal in the display indicates the RF output level. This provides considerable time saving during the alignment procedure. The option includes a differentiated pulse that provides a center frequency indication directly on the oscilloscope.

Another option provides up to five additional markers in the IF position. These are sharp, positive-going or negative-going pulses available at the rear panel, or negative differentiated pulses internally added to the demodulated envelope, and are derived from plug-in-crystal filters.

Other options include local oscillator tracking markers and a 13-channel switch assembly in place of the 36-channel switch assembly.

All optional features, as well as the circuits for the basic sweep generator, have plug-in modular construction. This allows optional features to be factory installed at the time of purchase or customer installed at a later date. This concept offers protection against obsolescence since updated and additional features can be simply and economically added as new tuner designs and test procedures dictate.

Maintenance problems can also be greatly simplified by the stocking of several modules instead of hundreds of discrete parts. Servicing time of a defective instrument can then be cut to a fraction of the time previously required, and service can be performed by relatively inexperienced technicians.

1.2 SPECIFICATIONS

1.2.1 RF OUTPUT

Normal Operation

36 detented bands at TV IF, TV channels 2 through 13, and CATV channels A through W. The specific center frequency of each band is (audio carrier + video carrier)/2.

Remote Operation

Center frequency continuously variable from less than 1 to greater than 400 MHz.

SWEEP WIDTH

Normal Operation

2 ranges; less than 1 to greater than 50 MHz and less than 10 to greater than 400 MHz.

Remote Operation

Less than 1 to greater than 400 MHz.

SWEEP RATE

AC line frequency (50 or 60 Hz).

BLANKING

RF output shut off during sweep retrace to provide a zero level baseline.

CONNECTOR

BNC

IMPEDANCE

75 ohms

AMPLITUDE

+57 dBmV (0.708 VRMS) to +2 dBmV (1.26 mVRMS)

FLATNESS

± 0.25 dB (measured with Wavetek Model D171 RF Detector).

DISPLAY LINEARITY

$\pm 2\%$

1.2.2 SCOPE HORIZONTAL OUTPUT

16 Vpp triangle waveform.

1.2.3 ATTENUATION

RANGE

Vernier
Step

0 to 20 dB continuous
0 to 35 dB in 5 dB steps

ACCURACY (Step)

+0.5 dB over full frequency range.

1.2.4 PROGRAMMING

Rear-panel REMOTE jack provides connections for remote control of center frequency, sweep width, and the 0 to 20 dB VERNIER ATTENUATOR.

1.2.5 MARKERS

Pulse-type, crystal-controlled at video and audio carrier frequencies (see table below).

FREQUENCY	CHANNEL	VIDEO CARRIER	AUDIO CARRIER
	IF	45.75	41.25
	2	55.25	59.75
	3	61.25	65.75
	4	67.25	71.75
	5	77.25	81.75
	6	83.25	87.75
	A	121.25	125.75
	B	127.25	131.75
	C	133.25	137.75
	D	139.25	143.75
	E	145.25	149.75
	F	151.25	155.75
	G	157.25	161.75
	H	163.25	167.75
	I	169.25	173.75
	7	175.25	179.75
	8	181.25	185.75
	9	187.25	191.75
	10	193.25	197.75
	11	199.25	203.75
	12	205.25	209.75
	13	211.25	215.75
	J	217.25	221.75
	K	223.25	227.75
	L	229.25	233.75
	M	235.25	239.75
	N	241.25	245.75
	O	247.25	251.75
	P	253.25	257.75
	Q	259.25	263.75
	R	265.25	269.75
	S	271.25	275.75
	T	277.25	281.75
	U	283.25	287.75
	V	289.25	293.75
	W	295.25	299.75

NOTE: Marker frequencies for Options A-71, A-73, and B are specified by the customer.

AMPLITUDE

0 to approximately 8 Vpp at front-panel SCOPE VERT OUT connector. 0 to approximately 30 V (switchable polarity) at rear-panel PULSE MARKER OUTPUT connector.

WIDTH

Approximately 1% of horizontal display.

ACCURACY

±0.02% (+25 kHz - 0 Hz) measured from leading edge

PRESENTATION

Normal pulses from rear-panel PULSE MARKER OUTPUT connector for z-axis modulation. Differentiated pulses from front-panel SCOPE VERT OUT connector.

1.2.6 GENERAL

POWER REQUIREMENTS

115 or 230 VAC, $\pm 10\%$ 50 or 60 Hz. Approximately 20W.

DIMENSIONS

Height

14.3 cm (5 5/8 in)

Width

21.0 cm (8 1/4 in)

Depth

34.9 cm (13 3/4 in)

Weight

9.1 kg (20 lb.) net

11.4 kg (25 lb.) shipping.

1.3 OPTIONS

1.3.1 OPTION A-71

Up to five extra pulse markers at customer-specified IF frequencies may be added to the instrument (module M13H). These markers are controlled by the front-panel IF MARKER pushbutton switches.

1.3.2 OPTION A-73

A second pair of pulse markers at customer-specified frequencies may be added (module M6P). These markers appear on each channel in addition to the normal channel markers.

1.3.3 OPTION B

Local Oscillator Tracking generates two pulse markers based on the IF output frequency from a tuner. These markers indicate RF bandwidth, local oscillator frequency, and tracking (module M7E). The markers can be any two frequencies within the IF input frequency range. With the addition of a capacitor, a channel-center pulse can be added if desired.

IF INPUT

Frequency

28 to 47 MHz

Minimum Level

Approximately 1 mV at IF IN connector (Z in = 50 ohms).

1.3.4 OPTION C

Automatic Level Control And Scope Indicators provides automatic adjustment of the 0 to 20 dB VERNIER ATTENUATOR to correct for variations in the gain of the tuner under test. Also provided are visual indications of the instrument's center frequency and RF output level (module M8E).

1.3.5 OPTION D

A 70 dB (10 dB/step) Step Attenuator is available to replace the standard 35 dB (5 dB/step) Step Attenuator to provide greater RF output level range (7570-01).

1.3.6 OPTION F

A 13 channel VHF TV channel switch is available to replace the 36 channel switch normally used.

1.3.7 OPTION G

An extra channel switch and four-foot extension cable is available to provide remote channel selection (available with either 13 or 36 channel switch).

1.4 ACCESSORIES

1.4.1	Furnished with instrument	Instruction manual
		Spare plug and pins to mate with rear-panel REMOTE jack.
1.4.2	Available at extra cost	RF Detector (Model D171).
		External Amplifier Probe (Model RB) provides additional IF gain which lowers the input requirement for Option B.
		Module Service Kit (K102) contains module extender and extension cables.
		Rack Mount Kits (K103, K104) enable mounting of instrument in a standard 19 inch instrument rack.

SECTION 2

OPERATING INSTRUCTIONS

2.1 INTRODUCTION

This section provides complete installation and operating instructions for the Wavetek Model 1402A. These instructions include information on the mechanical installation, electrical installation, front-and-rear-panel features, and operating procedures.

2.2 MECHANICAL INSTALLATION

2.2.1. INITIAL INSPECTION

After unpacking the instrument, visually inspect external parts for damage to knobs, connectors, surface areas, etc. The shipping container and packing material should be saved in case it is necessary to reship the unit.

2.2.2. DAMAGE CLAIMS

If instrument received has been damaged in transit, notify carrier and either the nearest Wavetek area representative or the factory in Indiana.

Retain shipping carton and packing material for the carrier's inspection.

The local representative or the factory will immediately arrange for either replacement or repair of your instrument without waiting for damage claim settlements.

2.2.3 RACK MOUNTING (K103 SINGLE KIT)

CONTENTS (See Figure 2-1).

ITEM	QTY	PART NO.
A (Side)	1 ea.	B000-608
B (Side)	1 ea.	C000-691
C (Screw)	8 ea.	HS101-806

PROCEDURE

Remove the screws from one side panel. Mount item A or B against side panel of the instrument and secure with screws provided. Repeat for other side of unit. Items A and B may be interchanged to position the instrument on desired side of rack.

2.2.4 RACK MOUNTING (K104 DUAL KIT)

CONTENTS (See Figure 2-2).

ITEM	QTY	PART NO.
A (Tray)	2	C000-729
B (Side)	2	C000-730
C (Handle)	2	HH101-002
D (Screw)	12	HS106-905
E (Screw)	4	HS103-908

PROCEDURE

Install both sides (item B) to one tray (item A) using the 10-32 x 5/16 thrust head screws (item D) provided. Position the instruments on the tray so that the instrument feet extend into the holes in the tray. When the instruments are properly seated, install the top tray (other item A) and secure with the remaining thrust head screws (item D).

NOTE

If the instrument being mounted is equipped with a bail, the bail must be removed prior to installation in the K104 Rack Mount Kit.

The handles (item C) are fastened to the sides with the 10-32 x 1/2 round head screws (item E).

Mounting holes are provided for front mounting of instrument rear-panel connectors, if desired.

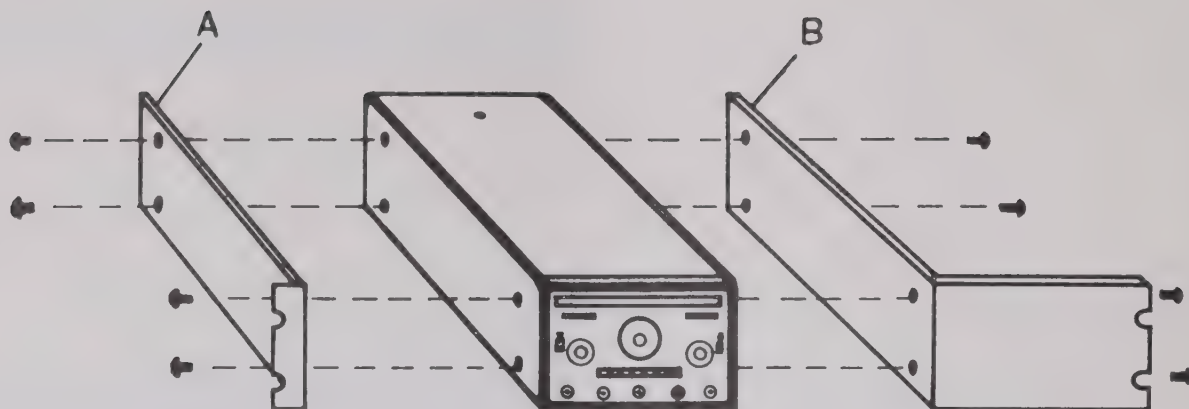


Figure 2-1. K103 Rack Mounting

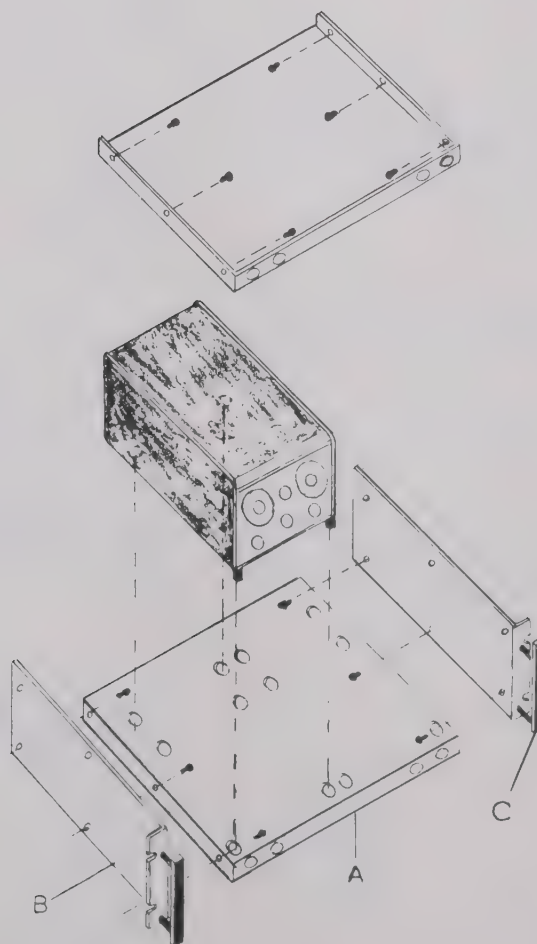


Figure 2-2. K104 Rack Mounting

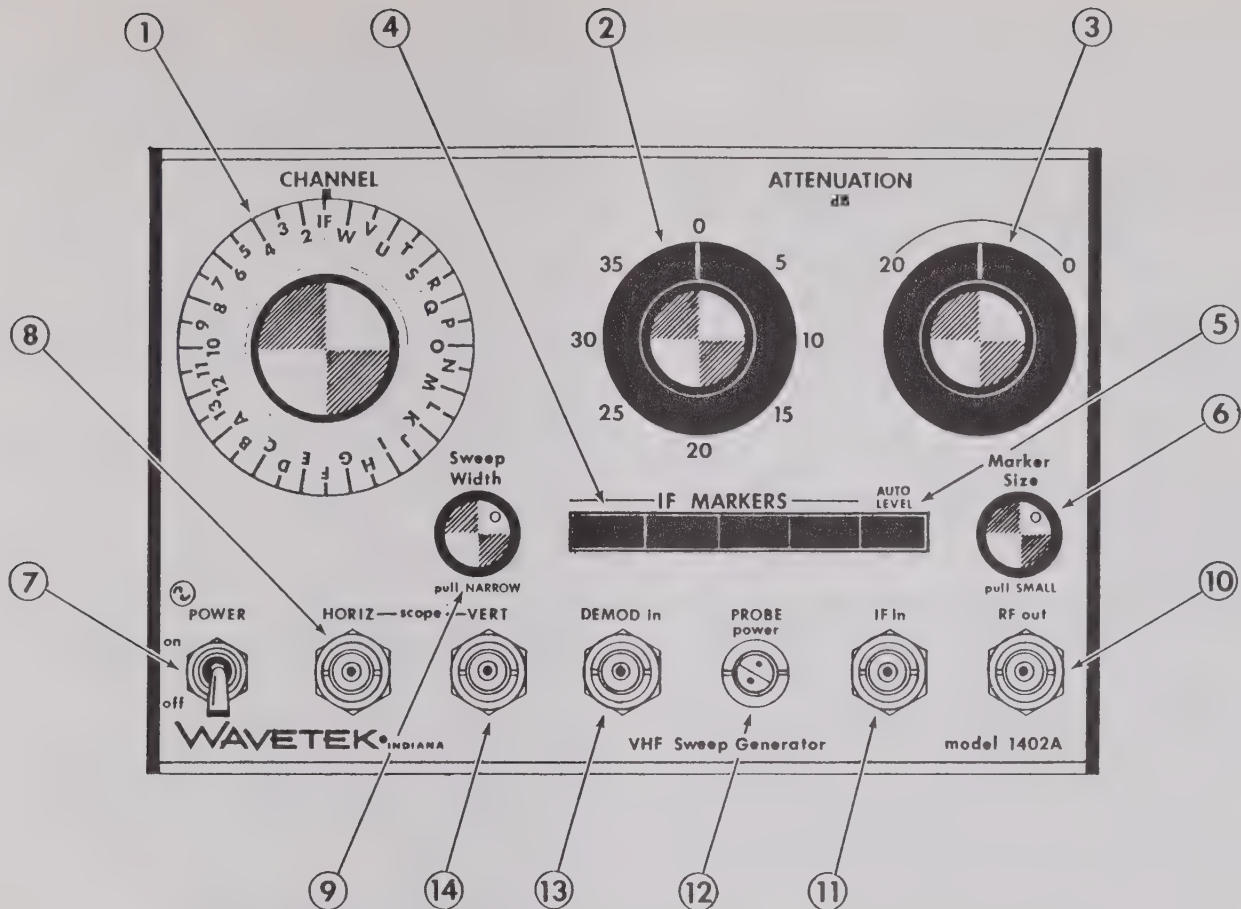


Figure 2-3. Front Panel

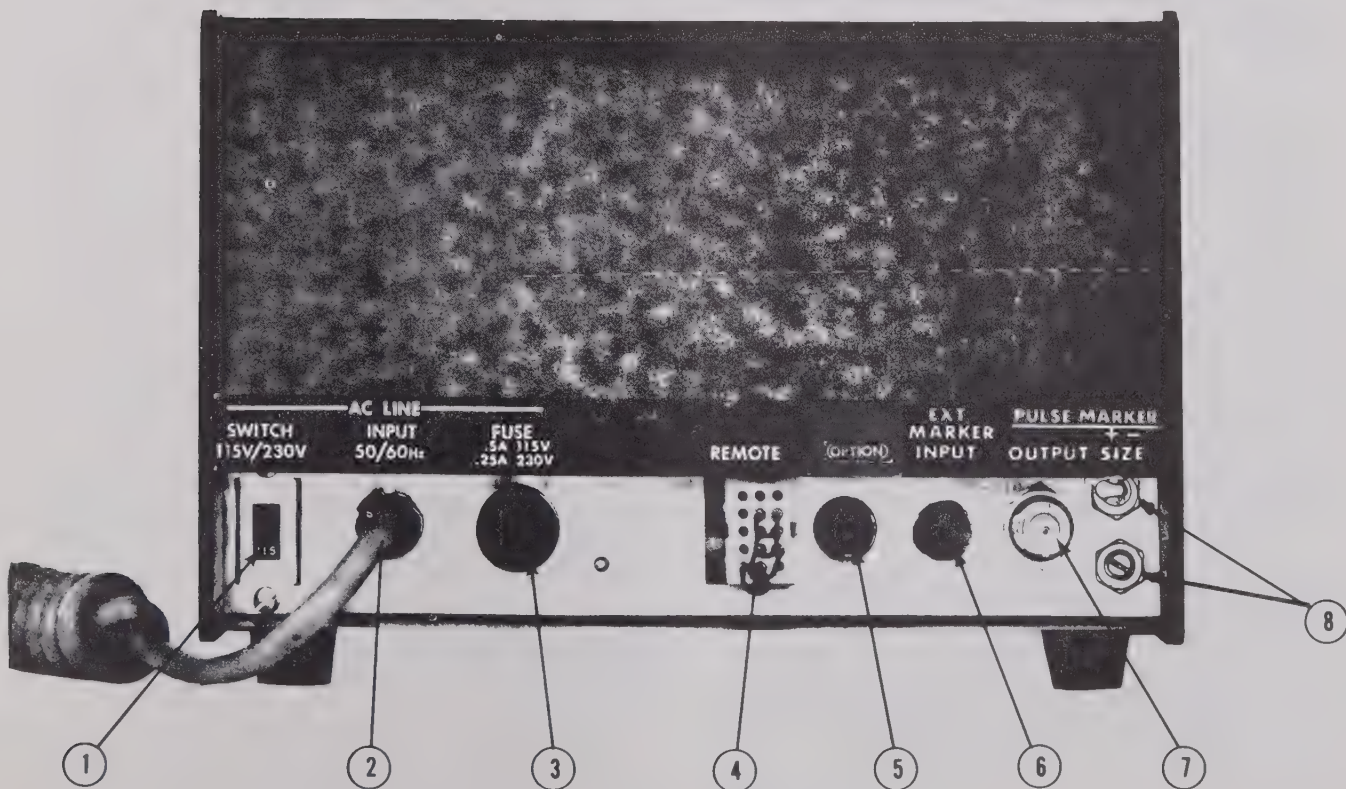


Figure 2-4. Rear Panel

2.3 ELECTRICAL INSTALLATION

The Wavetek Model 1402A can operate from either 115 VAC or 230 VAC supply mains. The rear-panel AC LINE SWITCH selects which of these operating voltages is being used, and adjusts the Power Supply accordingly. The Power Supply is designed to operate at an AC supply frequency of 50 or 60 Hz.

Instruments are shipped from the factory set up for 115 V operation unless otherwise specified.

NOTE

Before operating the instrument, check that the rear-panel AC LINE FUSE is the correct value for the supply voltage (see Section 2.5).

2.4 DESCRIPTION OF FRONT PANEL

(1) CHANNEL switch selects the center frequencies of IF, TV channels 2 to 13 and CATV channels A to W. The switch also turns on the correct RF markers for each channel.

(2) STEP ATTENUATOR provides calibrated adjustment of the RF output in 5 dB increments from 0 to 35 dB.

(3) VERNIER ATTENUATOR provides a 20 dB vernier adjustment of the RF output. When the AUTO LEVEL pushbutton is depressed or when the instrument is in remote operation, this control is not active.

(4) IF MARKER pushbutton switches control up to five IF markers (Option A-71). The fourth switch controls two markers. Marker frequencies are engraved on pushbuttons.

(5) AUTO LEVEL switch, when depressed, controls the automatic level circuit (Option C), and disconnects the front-panel VERNIER ATTENUATOR.

(6) MARKER SIZE control adjusts the amplitude of pulse markers added to the demodulated envelope at the SCOPE VERT connector. When the knob is pulled out, the marker size is reduced 90%.

(7) POWER switch applies AC power to the Power Supply. The light indicates that the instrument is operating.

(8) SCOPE HORIZ connector (type BNC) provides a 16 Vpp triangle waveform to drive the oscilloscope horizontal amplifier.

(9) SWEEP WIDTH control adjusts the display sweep width. When the knob is pulled out, the maximum sweep width is reduced to 50 MHz. When the knob is pushed in, the maximum sweep width is 400 MHz.

(10) RF OUT connector (type BNC) provides connection for the RF output signal.

(11) IF INPUT connector (type BNC) accepts an IF sweep sample to generate IF conversion local oscillator tracking markers when Option B is installed.

(12) PROBE POWER connector (type BNC twinax) supplies +18 volts and -18 volts to power the active probe if it is required for operation of Option B or Option C.

(13) DEMOD IN connector (type BNC) accepts the demodulated swept signal from the device under test so that markers and scope frequency and level indicators may be added, if Option C is provided. This signal is also used to control the automatic RF level circuits of Option C.

(14) SCOPE VERT OUT connector (type BNC) provides the combined markers and demodulated RF and scope indicators (when DEMOD IN is connected) for connection to the oscilloscope vertical (Y) axis input when Option C is installed.

2.5 DESCRIPTION OF REAR PANEL

(1) AC LINE SWITCH enables instrument to operate from either 115 VAC or 230 VAC supply mains.

(2) AC LINE INPUT cord provides connection to AC mains via 3 prong plug.

(3) AC LINE FUSE is time-delay; 0.5 for 115 VAC operation, 0.25 for 230 VAC operation.

(4) REMOTE jack and plug provide connections for programming of frequency and RF output level.

(5) OPTION mounting hole for BNC connector.

(6) EXT MARKER INPUT mounting hole for BNC connector.

(7) PULSE MARKER OUTPUT connector (type BNC) provides positive or negative pulse markers from Option B when installed.

(8) PULSE MARKER SIZE switch selects either negative or positive marker pulse. Control adjusts the amplitude of the pulses from 0 to more than 30 volts.

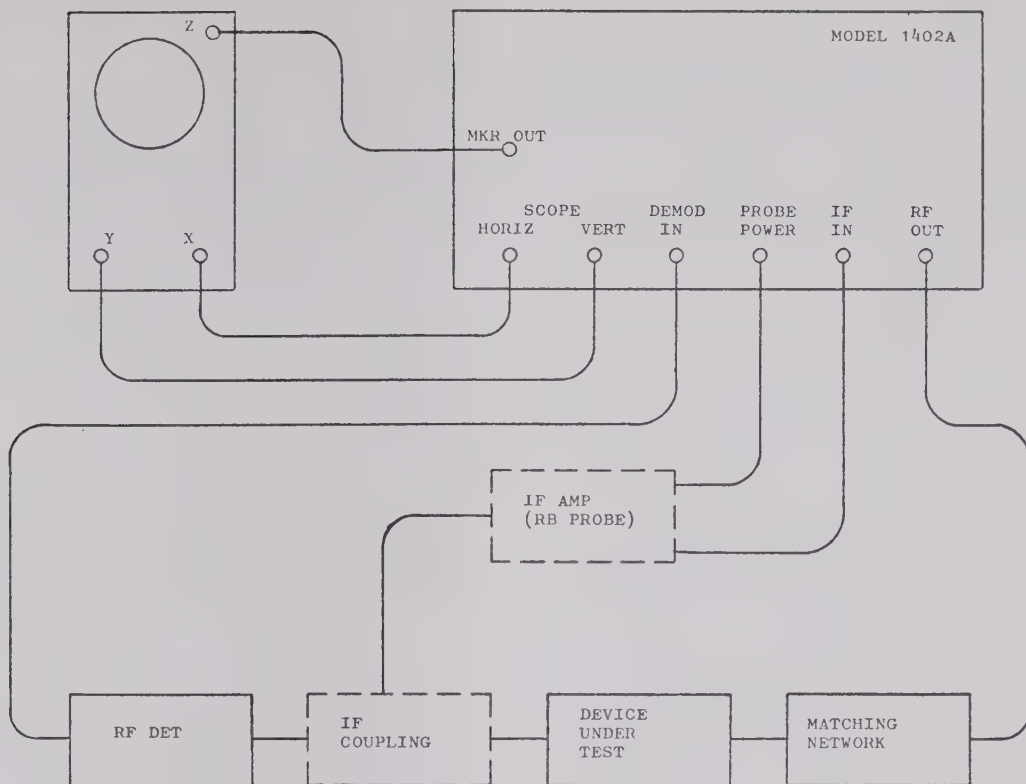


Figure 2-5. Typical Set-up

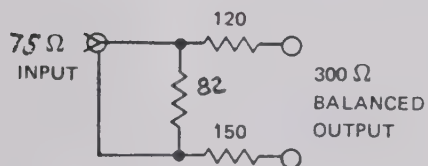


Figure 2-6. Resistive Pad

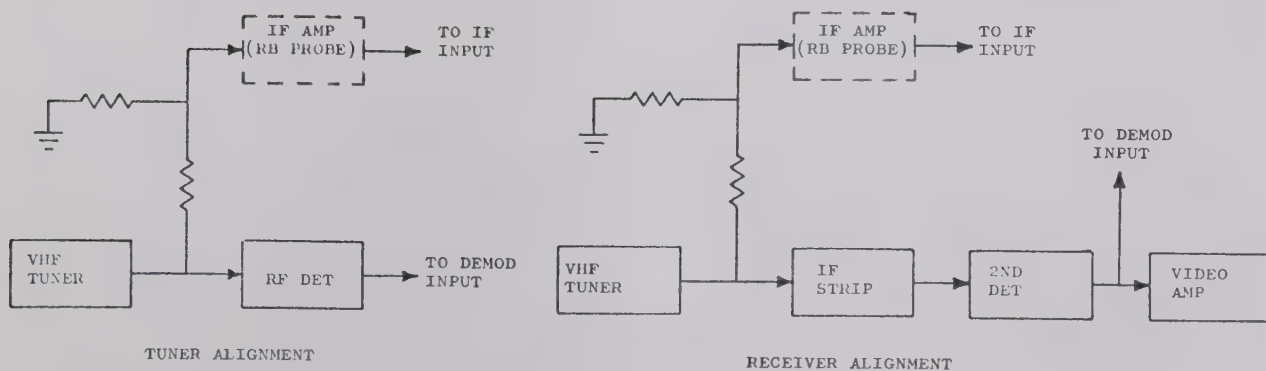


Figure 2-7. Typical Option B IF Coupling

2.6 TYPICAL OPERATING SET-UP

When initially setting up instrument, first check the rear-panel AC LINE SWITCH and FUSE to ensure the instrument is set for operation with the available AC mains. When Option C, Automatic Level And Scope Indicators, is to be used, refer to Section 2.6.1 for adjustment of internal controls required for proper operation. Be sure the AUTO LEVEL pushbutton is OUT before completing the set-up for manual operation.

Make connections between the sweep generator, the device under test and the oscilloscope as shown in Figure 2-5. Since hum, RF leakage, and spurious signal pickup must be kept at a minimum, it is essential that good connections and ground be maintained throughout the entire set-up. Coaxial cables with type BNC connectors should be used wherever possible.

The RF output cable is especially critical. It must have a characteristic impedance identical to that of the sweep generator (75 ohms). The cable should be kept as short as practical (under 3 feet). A matching network must be used between the 75 ohm RF output cable and the 300 ohm balanced input of the tuner to ensure a constant-amplitude input signal to the tuner. Either a resistive pad (Figure 2-6) or a transformer matching network may be used. While the resistive pad is simple to construct, it provides more insertion loss than the balun-type transformer. The leads connecting the 300 ohm output of the pad to the tuner should be as short as possible (under 1 inch).

After the RF swept signal passes through the RF circuits of the device under test, it must be detected (demodulated) before being connected to the DEMOD IN connector or the scope vertical. In the case of TV receiver alignment, the detector is already provided as a part of the receiver, while in aligning a tuner, an external detector must be used. The detected signal is then connected to the DEMOD IN connector on the front panel.

When Option B, IF Conversion Local Oscillator Tracking markers are used, an IF signal of 1 millivolt or more must be supplied to the front-panel IF IN connector. This IF signal can be provided directly from the IF output signal of the device under test, or from the IF amplifier contained an external probe. If the probe is used, the required IF input from the device under test is 10 microvolts instead of 1 millivolt. This provides for a greater operating range of the marker and looser coupling to the device under test. If IF markers are desired at trapped frequencies, the IF pickup must occur before the frequencies are trapped out, see Figure 2-7.

Switch AC power on. The lamp should light, indicating an operating condition.

NOTE

This instrument requires no warm-up, and is ready for immediate use.

After making the necessary connections, set the AUTO LEVEL SWITCH, CHANNEL SWITCH, STEP and VERNIER ATTENUATORS, and SWEEP WIDTH as required. Turn on the IF markers (if desired) and adjust the MARKER SIZE control for optimum display.

NOTE

The VERNIER ATTENUATOR is inoperative in auto level operation.

2.6.1 INTERNAL SET-UP CONTROLS

The internal controls, located on module M8E, are used only when Option C, Automatic Level And Scope Indicators is installed. The controls are set according to the characteristics of the device under test, the type of alignment set-up used, and the operator's discretion to produce the desired display.

The instrument top cover must be removed to provide access to the M8E controls. Remove the single screw at the rear of the cover and lift the cover with a slight rearward movement.

GENERAL DISCUSSION

The main objective of RF tuner and other amplifier alignments is to maintain the circuit gain within the specified limits while retaining an acceptable pattern flatness at the desired pass band. With the detected response amplified to a level which would provide a scope pattern of 1 Vp, given typical limits as shown in Table 2-1, the scope display could vary as shown in Figure 2-8.

By observing the pattern amplitude, we could determine that the tuner gain is within acceptable limits, but the pattern flatness would be difficult to estimate. With Option C, the pattern amplitude is maintained at a fixed level of 1 volt by automatically controlling the RF input level. Flatness is now easy to determine; however, the tuner gain would not be known without knowing the RF input level. Option C provides a level indicator pedestal on the base line of the tuner response pattern proportional to the RF output of the instrument, and therefore inversely proportional to the gain of the tuner. For example, when the indicator is at maximum amplitude (1 volt), the RF output level is 0 dB. If there is even less tuner gain, the pattern will become less than 1 volt while the indicator is saturated at 1 volt. As the tuner gain increases, the pattern will return to 1 volt and not increase further, while the indicator will decrease in amplitude on a linear voltage scale (see Figure 2-9).

TABLE 2-1		
TUNER GAIN DESIGN LIMITS		
CHAN.	LOW GAIN	HIGH GAIN
2	+30 dB	+42 dB
13	+24 dB	+34 dB

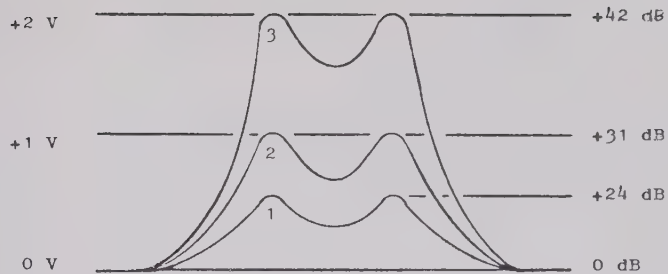


Figure 2-8. Typical Scope Displays

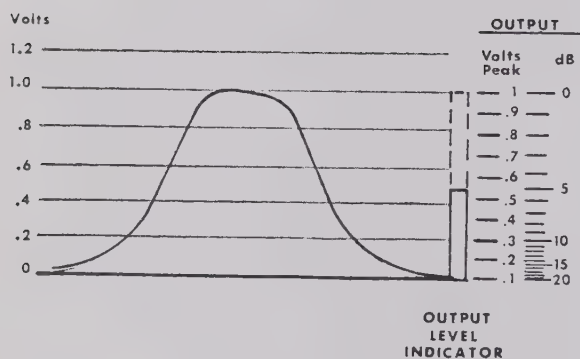


Figure 2-9. Option C Scope Display

VOLTAGE/SIGNAL SOURCES

Pin 1 Ground
Pin 2 +18 V
Pin 3 -18 V
Pin 4 Sweep Ramp

CONTROL INPUTS

Pin 6 Output Level
Pin 9 Output Frequency
Pin 12 Sweep Width

INTERNAL CONTROLS

Pin 5 Vernier Att.
Pin 8 Channel
Pin 11 Sweep Width

Pins 13, 14, 15 are used only in 1402A/1503 combined operation.

Pins 4, 7 are unused.

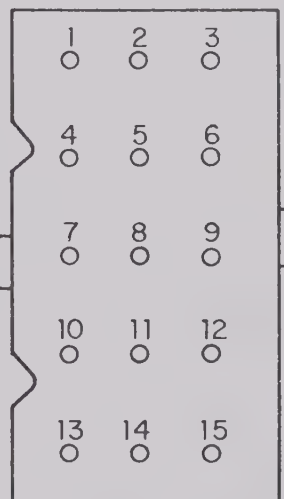


Figure 2-10. REMOTE Jack

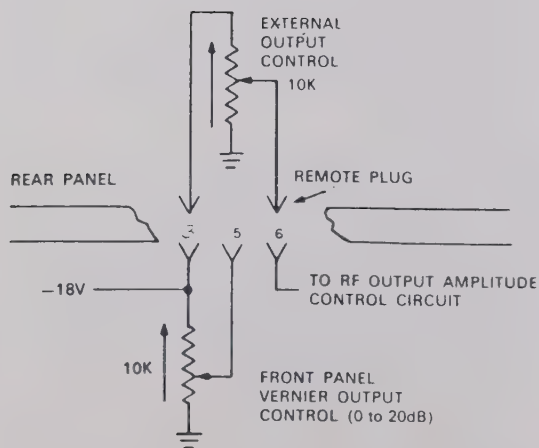


Figure 2-11. External Level Control

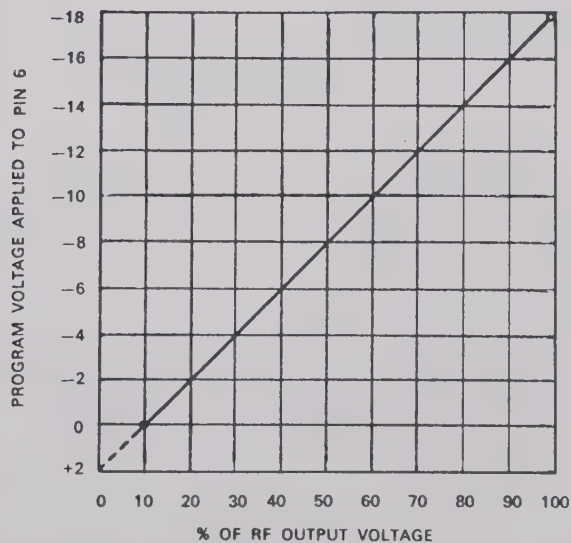


Figure 2-12. Program Voltage/RF Output

Internal set-up controls provide up to 40 dB of DC gain in order to interface with either low or high level detected tuner output signals. Since the option requires a positive detected signal, a polarity reversing switch is also provided.

SET-UP INSTRUCTIONS

Connect the equipment as shown in Figure 2-5 for normal manual operation. Remove the top cover of the instrument and adjust the controls on the M8E module as follows:

Var Gain	full CCW, (no gain)
Gain x 10	switch to right (no gain)
Polarity	switch for a positive pattern

While switching the Polarity switch between positive and negative, adjust the M8E Bal control until the display base line does not shift when the Polarity switch is changed.

Reduce the oscilloscope's vertical gain to 1 V full scale and switch the M8E Gain x 10 switch to the left (20 dB gain). The tuner response pattern should now be visible. Turn the Var Gain control clockwise, if necessary, to obtain a 1 V pattern. Note the amplitude of the RF level indicator pedestal.

Depress the AUTO LEVEL pushbutton and readjust the Var Gain control to restore the RF level indicator pedestal to the same amplitude it had in manual operation. The instrument's RF output level (0-20 dB VERNIER ATTENUATOR) is now operating automatically.

The M8E module also provides a differentiated pulse which will change position on the base line relative to the center frequency of the instrument. The indicator Range and Cent controls are provided to allow it to cover the entire scope horizontal scan for the frequency range being used.

Switch the front-panel CHANNEL switch to the highest frequency channel being used. Adjust the M8E Range control so that the indicator pulse is positioned slightly in from the right end of the display.

Switch the CHANNEL switch to the lowest frequency channel being used. Adjust the Cent control to position the pulse the same distance in from the left end of the display as the pulse was from the right end in the above step.

NOTE

The Cent and Range controls interact, so the above procedure must be repeated until the pulse is positioned properly on both the highest and lowest frequency channels.

The oscilloscope horizontal axis may now be calibrated for the channels in use in ascending frequency.

2.7 SPECIAL OPERATING NOTES

2.7.1 EFFECTS FROM OVERLOADING

The use of excessive input signals to the device under test can cause overloading. To assure that this condition is not present, and that the response is a true representation of the device under test, set the STEP and VERNIER ATTENUATORS for minimum output amplitude. Gradually increase the output amplitude until a response is obtained. Further increase of the output amplitude should not change the configuration of the response envelope except in amplitude. If the response envelope does change, such as flattening at the top, decrease the output just far enough to restore the proper configuration.

2.7.2 MAKING MEASUREMENTS AT LOW LEVELS

When making measurements at low levels, radiation and ground loops become problems. Using double-shielded cables for carrying RF signals helps minimize the radiation problem. Ground loops causing hum pick-up can sometimes be eliminated by completing only one ground connection between each instrument. This applies particularly to the scope horizontal input. If the ground connection is made at the vertical input terminal, an additional ground at the horizontal input terminal will often result in hum pick-up.

2.8 PROGRAMMING

Connections for remote control of output level, center frequency, and sweep width are provided on the rear-panel REMOTE jack. Also provided are connections for remote coupling of an automatic VHF sweep generator (Wavetek Model 1503) to the Model 1402A. The REMOTE jack and its pin functions are shown in Figure 2-10.

Normal front-panel operation is provided by a REMOTE programming plug with jumpers between pins 5 and 6, 8 and 9, and 11 and 12.

2.8.1 OUTPUT LEVEL CONTROL

To provide external control of the 0 to 20 dB VERNIER ATTENUATOR, remove the jumper from pins 5 and 6 of the REMOTE plug and connect an external control as shown in Figure 2-11. The RF output is a linear function of the programming voltage as shown in Figure 2-12.

2.8.2 CENTER FREQUENCY CONTROL

To provide external control of center frequency, remove the jumper from pins 8 and 9 of the REMOTE plug and connect pin 9 to an external frequency control as shown in Figure 2-13.

2.8.3 SWEEP WIDTH CONTROL

To provide external control of sweep width, remove the jumper from pins 11 and 12 of the REMOTE plug and connect pin 12 to an external sweep width control as shown in Figure 2-14.

NOTE

The circuit as shown will control the wider sweep width range (up to 400 MHz). To externally control the narrower range (up to 50 MHz) normally activated by pulling the SWEEP WIDTH control out, a 91 kohm resistor should be connected between REMOTE plug pin 10 and the external sweep width control.

2.8.4 COMBINATION 1402A/1503 OPERATION

Figure 2-15 shows the typical set up for operation of a 1402A/1503 combination. The rear-panel REMOTE plugs of both instruments are removed, and a special combining harness assembly (K106) is substituted. The K106 harness also contains a UHF/VHF changeover switch (refer to Figure 2-16). The plug adjacent to the switch is installed on the rear panel of the Model 1503 (master). The plug further from the switch is installed on the Model 1402A (slave).

The Model 1503 must have Options B (Local Oscillator Tracking), C (Automatic Level And Scope Indicators), and E (Automatic Frequency) installed. The Model 1402A must have the M2E-1 Sweep Drive module replaced with an M2E-2. If Option C is installed in the Model 1402A, module M8E must be removed and replaced with an M8 module base. The AC line phase must be the same for both units.

The center frequency, sweep width, and output level (0-20 dB VERNIER ATTENUATOR range) of each instrument are controlled from the Model 1503, with the Model 1402A front-panel CHANNEL, SWEEP WIDTH, and VERNIER ATTENUATOR controls inactive. The UHF/VHF change-over switch selects which instrument is operating and which is in "standby".

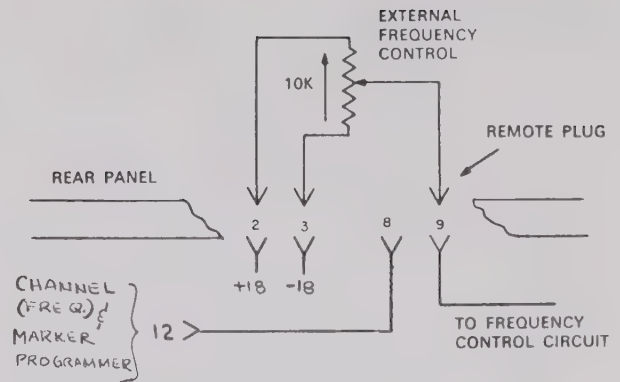


Figure 2-13. External Frequency Control

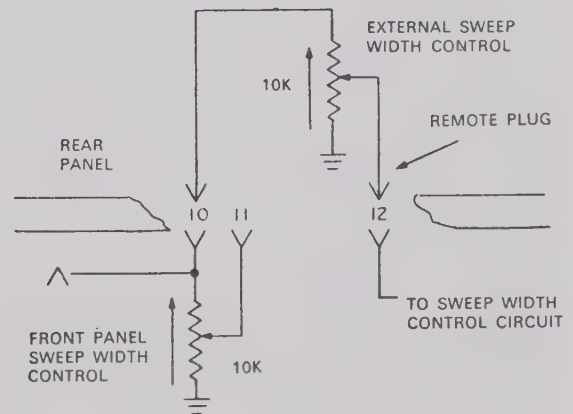


Figure 2-14. External Sweep Width Control

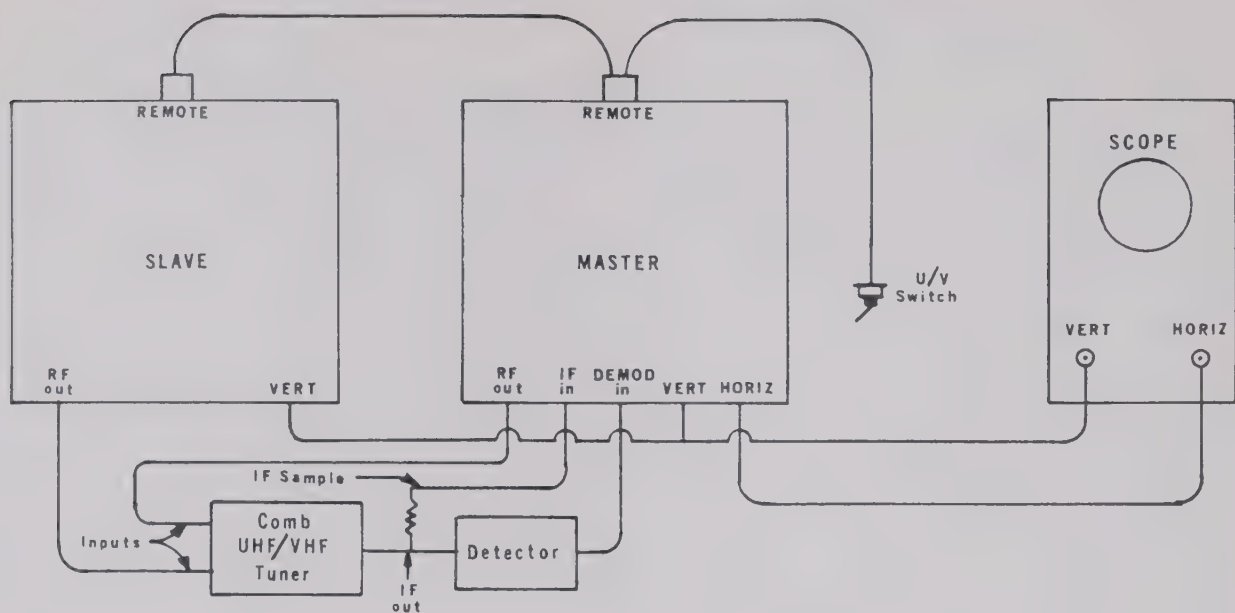


Figure 2-15. Combination 1402A/1503 Set-up

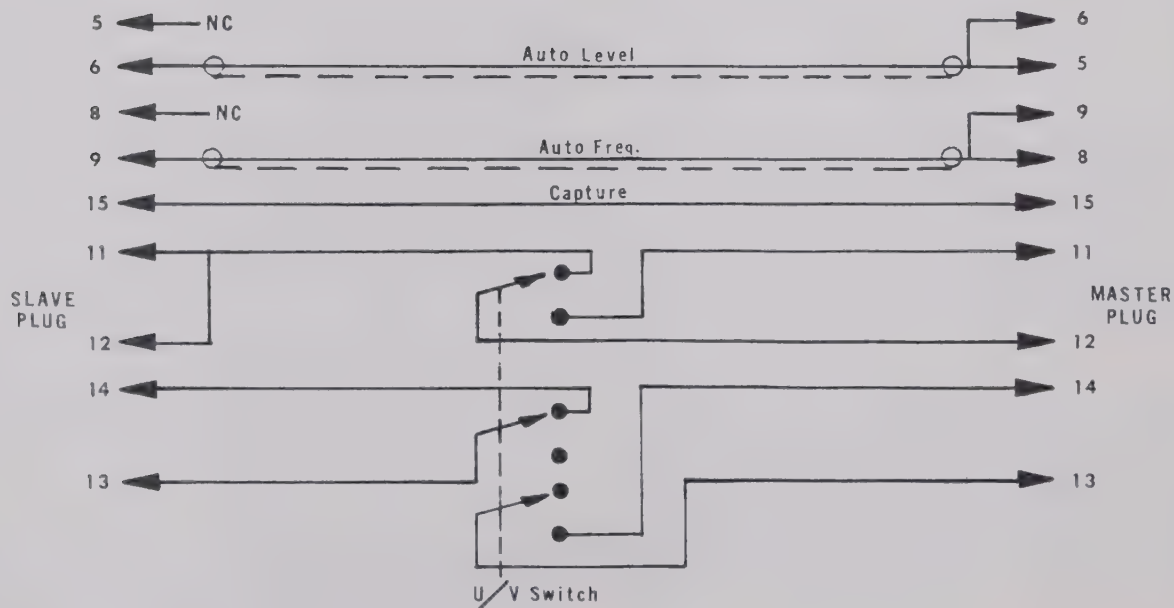


Figure 2-16. K106 Harness

SECTION 3

CIRCUIT DESCRIPTION

3.1 INTRODUCTION

This section first presents an overall block diagram analysis followed by a more detailed description of each module.

Before beginning the actual circuit description, it would be well to consider the mechanical arrangement of the instrument. This will enable the following block diagram and circuit description to be associated with its physical position, thereby, providing a better understanding of the overall instrument. The mechanical arrangement can be seen by referring to Figure 3-2.

3.2 SIMPLIFIED BLOCK DIAGRAM

The block diagram in Figure 3-1 contains both block and module information.

The Power Supply provides regulated ± 18 V sources, square wave and triangle wave generators for connection to the plug-in module, and a pulse marker amplifier circuit.

The two power sources provided the voltage to the front-panel CHANNEL switch while the triangle wave generator supplies the sweep ramp to the front-panel SWEEP WIDTH control. CHANNEL switch circuits set the tuning voltage required for each channel center frequency. The output signals from the CHANNEL SWITCH and SWEEP WIDTH control are then fed to the M2E-1 sweep drive module

where they are combined into a single signal which drives the frequency determining varactor diodes in the M9L Sweep Oscillator module. Necessary level shifting, shaping, and amplitude control is provided by the Sweep Drive circuit.

The square wave generator turns off the RF output and marker circuits during retrace, and controls the timing of other circuits in the instrument.

The RF Sweep Generator circuits are contained in two modules; an M9L Sweep Oscillator Module and an M10 GA Output Amplifier module.

The sweep signal is generated by heterodyning two UHF sweep oscillators in a diode mixer. The resultant difference signal is then amplified in a wide band amplifier and applied to the M10GA module. The M10GA module contains a voltage variable attenuator, the final output wide band amplifier, the monitor diode, and the leveling amplifier. The input signal from the M9L module is connected through the voltage variable attenuator to the wide band amplifier and then to the monitor point.

Leveling of the RF output is accomplished by the monitor diode which measures the RF voltage and compares it to a reference voltage supplied by the OUTPUT VERNIER control. Any error between the two voltages is amplified in the leveler amplifier located in the M10GA module. The error

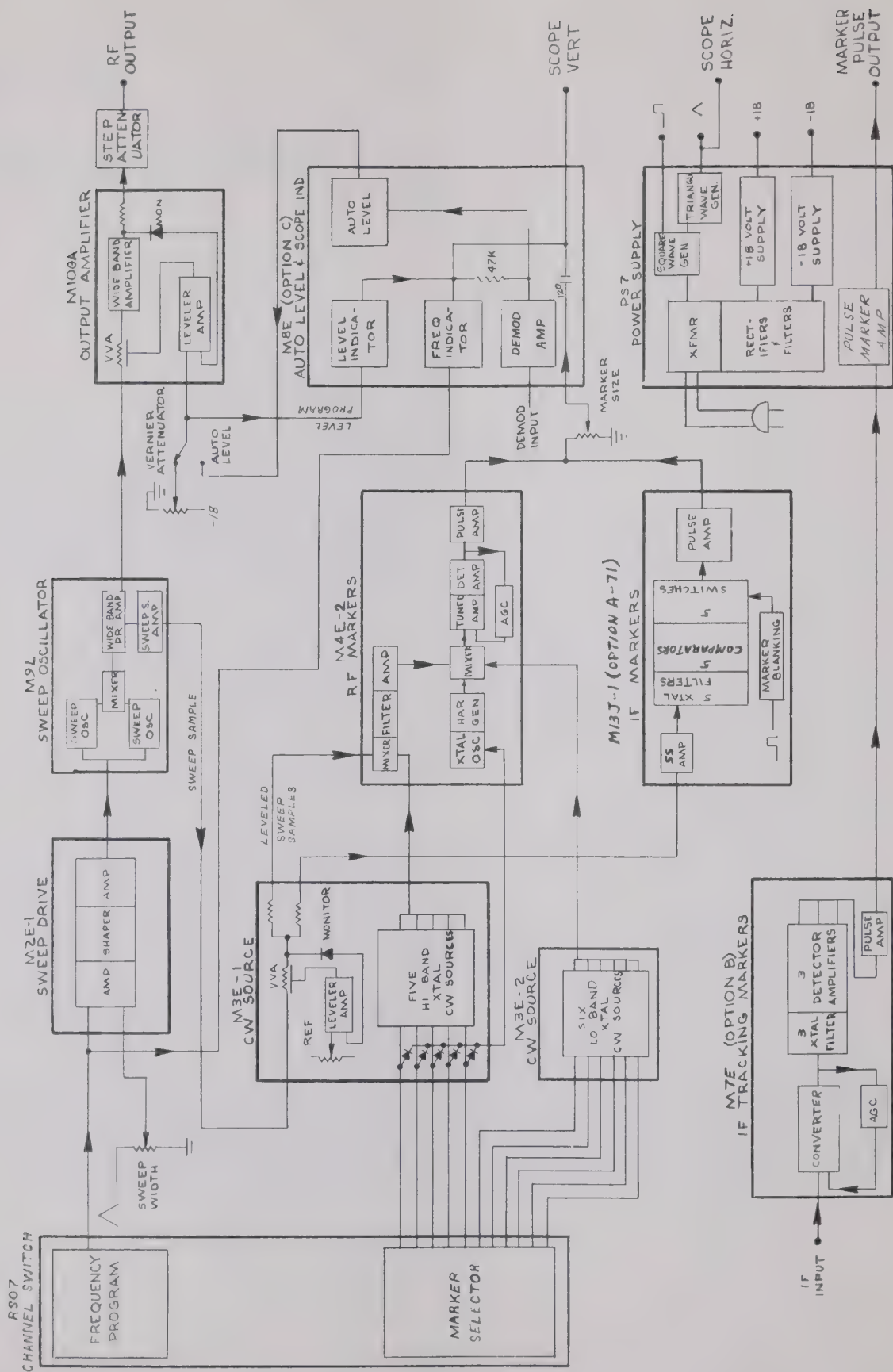


Figure 3-1. Block Diagram

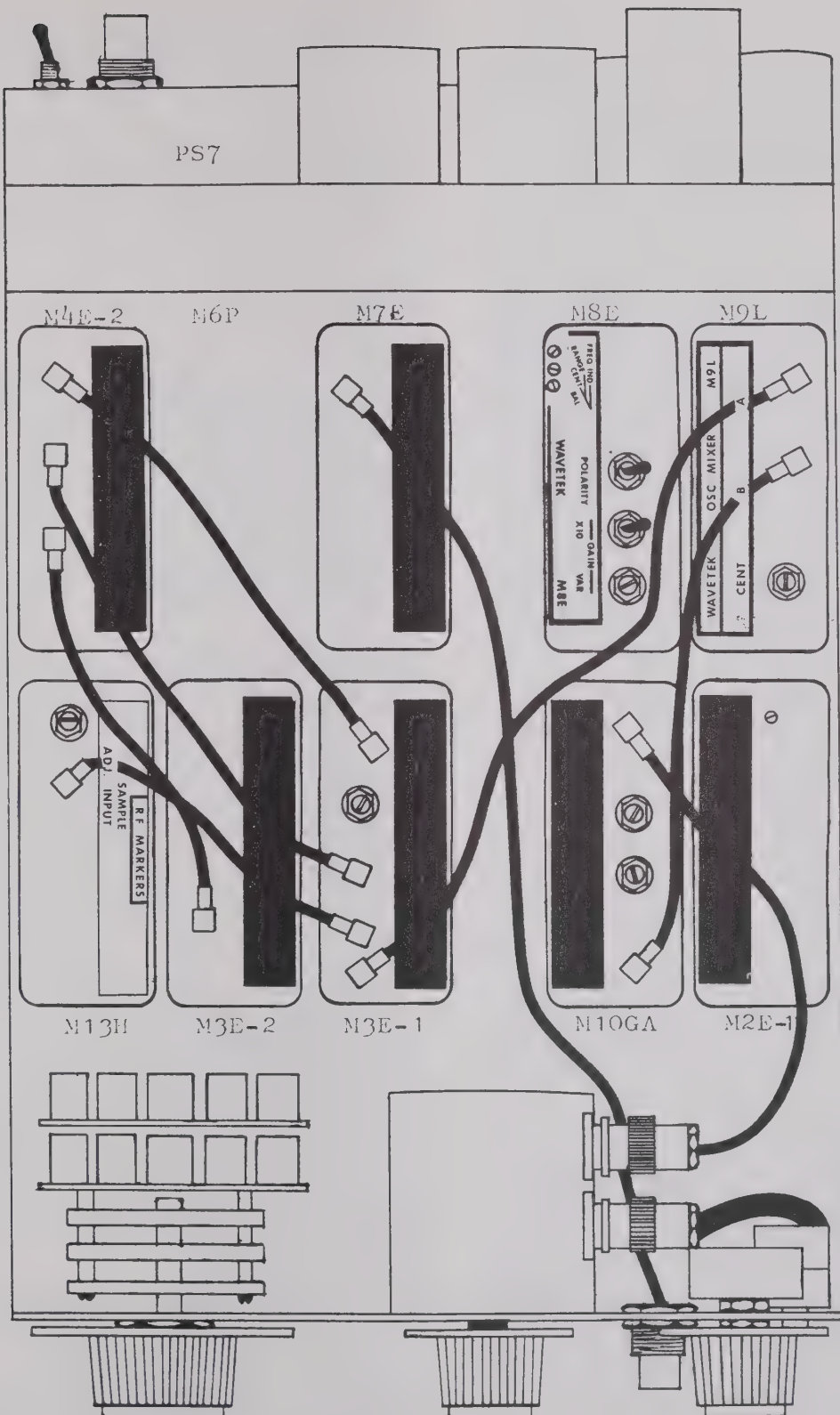


Figure 3-2. Top View

voltage is then connected to the voltage variable attenuator at the input of the final wide band amplifier. This closed loop system, which compensates for amplitude variations in the sweep oscillator, mixer, and amplifier circuits, also creates a zero impedance at the monitor point. In order to create a 75 ohm source impedance, a 75 ohm resistor is connected between the zero impedance point and the RF output system.

The output from the M10GA module is then connected through the Step ATTENUATOR to the front-panel RF OUT connector.

The marker circuit is composed of CW Source modules M3E-2 and M3E-1, RF Marker module M4E-2, and Marker Adder module, M8. The marker adding function of the M8 module is also contained in the Automatic Level module, M8E (Option C). The CHANNEL switch selects B+ voltage for the CW and harmonic sources required for each channel.

The M3E-2 module provides the crystal CW sources at the center frequencies of IF (channel 1) and channels 2 to 6. When the CHANNEL switch selects one of the six low channels, the proper source is turned on and routed to a diode mixer in the M4E-2 module.

Crystal CW sources for channels 8 to 12 are within the M3E -1. A steering diode at each source B+ supply line also activates a crystal-controlled oscillator and harmonic generator in the M4E-2 module, enabling the development of the RF markers of channels 7, 13, and A to W from the same crystal CW sources.

When the CHANNEL switch selects one of the 30 higher frequency channels, the proper source is turned on and routed to an FET mixer in the M4E-2 module.

In addition to providing CW sources, the M3E-1 module also provides for the leveling of the sweep sample signal in the same manner as the main RF output signal is leveled. This provides a constant-amplitude standardized sweep sample signal to the marker generating circuits in the M4E-2.

The M4E-2 module accepts the VHF sweep sample which has been leveled and standardized in the M3E-1 module, and a CW signal from either the M3E-1, (in IF and channels 2 to 6), or the M3E-2 (in channels 7 to 13 and A to W). The signals are heterodyned in a mixer circuit. This video signal is coupled to a dual gate MOS FET amplifier tuned to 2.25 MHz by LC tank circuits across one of its gates and in the drain load. The response is further amplified, demodulated, and sampled by an IC inverter which AGC's the tuned amplifier. The response is then amplified to saturation, producing sharp, negative-going pulses at the RF carrier frequencies. These two pulses are added to the demodulated envelope in the M8 module.

The CW sources used for channels 7 to 13 and A to S are heterodyned with the sweep sample in a MOS FET mixer and fed through a 100 MHz low pass filter to a second diode mixer which is also the primary mixer used for the six low channel markers. When in channel 7 to 13 or A to W, the beat signal is mixed with a signal from a 30 MHz crystal oscillator and harmonic generator activated by diode switches in the M3E-1 module, which repeats the zero beat at 30 MHz intervals. In this way, the CW source at the center frequency of channel 12, for example, serves as the source for channels E, 7, M, R, and W when selected by the CHANNEL program switch.

The optional IF marker circuit in the M13H module consists of a sweep sample amplifier, five independent plug-in crystal filters which generate the basic marker pulses in separate detector amplifier circuits, and a common pulse amplifier. The negative-going output pulses are added to the demodulated envelope in the M8 module.

The M7E module provides pulse-type local oscillator tracking markers generated from an IF sample from a TV tuner or receiver. The conversion circuits, which are AGC'd to prevent loss of markers from insufficient IF sample during tuner alignment, convert the IF sample to approximately 12.25 MHz. The converted signal generates RF markers in three crystal filters at converted equivalent frequencies. The crystal filter outputs are detected and amplified in identical detector/amplifier circuits, and are applied to the common marker pulse circuit which generates sharp negative-going marker pulses.

The marker pulses are routed to the marker pulse amplifier (in the PS7 Power Supply) which provides either positive-or-negative-going pulse markers at the rear panel.

The Option C automatic level, level indicator, and frequency indicator circuits are contained in the M8E module. The module also contains high-impedance adjustable-gain scope preamplifier circuits and pattern inverters to permit automatic leveling (attenuation) with either high-or-low-level tuners without using external DC amplifier probes. The level indicator pedestal, the frequency indicator pulse, and the marker signals from the front-panel MARKER SIZE CONTROL are combined with the demodulated input signal for connection with the scope vertical or Y axis input.

When Option C is not used, module base M8 is used in place of module M8E. In this module, the DEMOD IN is connected directly to the 47 kohm resistor. The marker signals are coupled through the 120 pF capacitor to the resistor and to the SCOPE VERT output connector. No other circuits are provided in this module.

THE FOLLOWING CIRCUIT DESCRIPTIONS ARE REFERENCED TO THE SCHEMATICS APPEARING IN SECTION 6.

3.3 POWER SUPPLY (PS7)

The PS7 Power Supply provides two regulated DC voltages, a square wave, a triangle wave and amplified marker pulses.

AC POWER & RECTIFIER CIRCUITS

A dual-primary transformer allows operation at a line voltage of 115 or 230 volts. AC power is supplied a 3-prong plug and is switched by the front-panel POWER switch. The transformer is located away from the Sweep Drive module to reduce magnetically-coupled line ripple.

Unregulated plus and minus voltages are supplied by two full wave rectifier circuits filtered by C1 and C7. A 12 pin plug, mounted to the printed circuit board, provides access to three unregulated voltages, the regulated ± 18 V supplies, square wave, triangle wave, and an input to the marker pulse amplifier. R45 is a series voltage dropping resistor for the power indicator, DS101.

+18 VOLT SERIES REGULATOR

Regulation is provided by IC1 which contains its own internal reference supply. Resistor R9 provides an adjustment to +18.00 volts. An external pass transistor, Q2, boosts the current capability, and transistor Q1 improves the current limiting characteristics of IC1 by providing amplification before limiting. The +18 volt supply is protected against reverse voltage by diode CR7.

-18 VOLT SERIES REGULATOR

The voltage reference for this supply is obtained from the +18 volt supply through resistor R20. Resistor R19 provides feedback, applied to IC2, which provides high gain, forcing transistor Q5 to maintain a regulated voltage at the collector. Transistors Q3 and Q4 provide the series pass element and are connected as a compound emitter follower so that the voltage across resistor R13 is not loaded heavily. Short-circuit protection of transistor Q4 is provided by diode CR8. Current limiting is provided by transistor Q5 when transistor Q6 conducts sufficiently to forward bias diodes CR9 and CR10. Reverse voltage protection is provided by diode CR12.

SQUARE WAVE GENERATOR

The 24 volts AC from power transformer T1 is squared by comparator IC3A. Diodes CR13 and CR14 provide protection to the inverting input by limiting the voltage

range to one volt. The square wave output drives the triangle generator input and is also applied to the base of Darlington emitter follower Q7. CR15 limits the negative output to one volt. A positive 15 volt, negative 1 volt square wave is routed to pin 10 of P2 where it is provided to blank the RF output during retrace and to control the timing of other circuits in the instrument.

TRIANGLE WAVE GENERATOR

The symmetrical square wave output of IC3A is adjusted by R26 and is AC coupled to integrator IC3B to restore symmetry about zero. Diodes CR16 and CR17 protect the inverting input by limiting the voltage range to one volt.

Capacitor C13 in the feedback network provides the integrator configuration. This signal, applied to pin 8 of P2, provides the sweep ramp and scope horizontal drive, and controls the timing of other circuits in the instrument.

MARKER AMPLIFIER

Negative-going marker pulses from the M7E and from the M4E-2 and M13H modules in the instrument are routed through pin 7 of P2 and AC coupled to the base of PNP inverter Q12. The collector signal is coupled through R41 to the base of NPN inverter Q13.

Positive-going pulses are selected from the rear-panel PULSE MARKER SWITCH, S2, and coupled to the MARKER SIZE control, R44. The pulse is then applied to the MARKER PULSE OUTPUT jack, J5.

3.4 CHANNEL PROGRAM SWITCH

The RS07 36-channel program switch provides an analog voltage to set the center frequency of the sweep oscillator. The switch also provides power for the appropriate channel markers.

The encoded logic switch (S1) presents a BCD code at pins 6, 7, and 8 of S1. A BCD "0" corresponds to 1F, "1" corresponds to channels 2-6, "2" corresponds to channels A-E, etc. This code is level-shifted by a resistor network (R87-R93) and decoded by a TTL one-of ten decoder (IC3). IC3 is powered by -18 V and -13 V (supplied by IC4). Each output of IC3 drives an inverting amplifier (Q41-Q48). Since only one output from IC3 is low, only one collector of 8 transistors is high. The high collector turns on a pair of FETs (for example, a high 2-6 signal turns on Q13 and Q14). Analog voltages corresponding to two TV channels are put on the two busses which drive the two voltage followers (IC1A and IC1B). (For 1F, the two analog voltages are identical.)

A resistor divider (R48-R52) provides analog voltages for in-between channels. For channels 2-6 only, Q22 is turned off, disconnecting shunt resistor R47 so that channels 4 and 5 will be 10 MHz apart instead of 6 MHz. Encoded logic switch S1 selects an analog voltage for the output voltage follower (IC2) by turning on one of five FETs (Q17-Q21). For example, if channel 2 is selected, +18 V at pin 1 of S1 will turn on Q21. The voltage at 2 will then appear at pin 12 of P102.

The channel markers receive power through pass transistors Q25-Q35. If IF is selected, Q23 is turned on, enabling pass transistor Q25. +18 V at pin 5 of S1 is applied to pin 1 of P102 through a saturated Q25. If 2-6 is selected, Q24 is turned on, enabling 5 pass transistors (Q31-Q35). +18 V is applied to the emitter of the appropriate pass transistor. If a channel other than IF or 2-6 is selected, Q37 and Q38 are both turned off, allowing Q36 to turn on. Five pass transistors (Q26-Q30) are enabled. +18 V is applied to the emitter of the appropriate pass transistor to turn on the appropriate oscillator. One oscillator may provide markers for as many as six channels.

3.5 SWEEP DRIVE (MODULE M2E-1)

The M2E-1 module provides the drive voltage to the varactor diodes in the Sweep Oscillator module as determined by the programming voltage applied to pins 5 and 7 of the M2E-1 by the CHANNEL and SWEEP WIDTH controls. R3, R4, and R41 divide the frequency program so that it is equal to the sweep width program. The programs are summed to a standard voltage level in input amplifier IC1A and then fed to the shaper circuit. The shaping diodes (CR1 through CR5) conduct at levels determined by a resistor string driven by constant current source Q1. As each diode conducts, an additional current is fed into the summing junction of the output amplifier, IC1B. The output amplitude is set by R31, the Sweep Width control.

3.6 SWEEP OSCILLATOR (MODULE M9L)

The RF sweep signal is developed by the heterodyne method which utilizes two UHF sweep oscillators, a diode mixer and a wide band amplifier.

Oscillator transistor Q2 sweeps from approximately 1.4 to 1.65 GHz. The average frequency is adjusted by resistor R3, which controls the average bias on the varactor diodes, CR1, CR2, and CR3. The sweep drive voltage from pin 9 of the module is connected to the opposite side of these diodes, causing the frequency to vary.

Oscillator transistor Q10's circuit is similar to Q2's circuit; however, the varactor diodes have been reversed and the polarity of the bias voltage supplied by R22 and R23 has been changed. These changes cause the oscillator frequency

to vary in a high-to-low frequency direction. The approximate output frequency is 1.4 to 1.5 GHz. This out-of-phase sweep has several advantages. First, larger sweep widths are obtainable and second, the nonlinearity (frequency verses time) of one oscillator is cancelled by the nonlinearity of the second oscillator. Resistor R9, which is a linearity adjustment, optimizes this cancelling process by controlling the sweep drive ratio between the oscillators.

The two sweep signals are combined in a single-balanced diode mixer composed of inductors L4 and L11, and diodes CR4 and CR5. The resultant difference frequency of 0 to 500 MHz is then amplified in the wide band amplifier consisting of transistors Q3, Q5, and Q6.

Transistors Q4 and Q9 supply the blanking voltage to the wide band amplifier and cause it to be shut off during the sweep retrace time. The output from the wide band amplifier is connected to J1, which in turn is connected to the Output Amplifier module M10GA. A second output is coupled via resistor R34 to a similar wide band amplifier consisting of transistors Q11, Q12 and Q13. The output from this amplifier is connected to J2, which in turn is connected to the marker generating circuits.

3.7 OUTPUT AMPLIFIER (MODULE M10GA)

The M10GA module contains an electronic attenuator, a wide band amplifier, an output monitor and a leveler.

ELECTRONIC ATTENUATOR

Ahead of the first RF amplifier is an electronic attenuator consisting of PIN diodes CR1, CR2, and CR3, which provides variable RF conductance proportional to the positive current applied through transistor Q9.

WIDE BAND AMPLIFIER

This amplifier provides 2 stages of RF amplification to increase the RF input level present at transistor Q1 by about 40 dB, with a reduced frequency response for frequencies below 0.5 MHz. Each amplifier, Q1 and Q4, is followed by two emitter followers, Q2/Q3 and Q5/Q6.

MONITOR AND LEVELER

The output of the wide band amplifier is connected to monitor diode CR8. The negative detected voltage is connected to one input of the leveler amplifier consisting of Q8, Q9, and Q10.

The second input to the leveler amplifier is provided by the level control. Any error between the two inputs is

amplified and used to control the electronic attenuator. This closed-loop system maintains zero impedance and constant amplitude signal at the monitor point, and allows an adjustment of the output over a 20 dB range.

A positively increasing output voltage from the leveler amplifier will increase the RF output level. RF blanking is effected by a positive input voltage (pin 4) to switching transistor Q7 which causes the leveler amplifier output to go negative during retrace time, shutting off the electronic attenuator.

The output impedance is provided by resistor R31 connected between the monitor diode, CR8, and the RF connector, J2.

3.8 CW SOURCE (MODULE M3E-1)

CW Source module M3E-1 contains the five crystal-controlled oscillator and frequency multiplier circuits that provide markers for the high band VHF TV channels and the CATV channels. It also contains a sweep sample leveler.

The crystal oscillators (transistors Q1A through Q1E) are tuned-Colpitts types with the crystals operating at their third overtone frequencies in series resonant mode. The tuning suppresses the crystal fundamental and higher-order resonant frequencies.

The output signals of the crystal oscillators are capacitively coupled to the base of the frequency multiplier transistors, Q2A through Q2E, with parallel resonant LC tanks tuned to the fourth harmonic of the crystal oscillator outputs forming the collector loads. Sympathetic tank circuits, tuned to the the same frequency, transformer couple the center frequency CW signal through capacitors C12A through C12E to the CW output jack J1.

The oscillators and frequency multipliers are switched on one at a time by B+ voltage applied to feedthrus C6A through C6E. Diodes CR1A through CR1E apply B+ voltage to pin 7 when any CW source in the module is switched on. This voltage at pin 7 is the B+ source for a crystal-controlled oscillator and a harmonic generator in the M4E-2 module, used to heterodyne to the center frequencies of the high band VHF TV channels and CATV channels other than channels 8-12. PIN diodes CR2A through CR2E, in series with the output coupling loop, provide an RF block to prevent the CW source output from ringing with the output tanks of an inactive source circuit.

A low-level sweep sample signal, supplied from the oscillator/mixer module M9L, is connected to jack J2.

This signal is then leveled. The voltage from the monitor diode, CR4, and the reference voltage from R19 are fed to the leveling amplifier consisting of transistors Q4 and Q5. Q3 provides blanking of the leveling amplifier. Any error between the two input signals is amplified and fed to the PIN diode attenuator, CR3. The operation of this circuit produces a constant amplitude signal at the monitor point. Resistors (47 ohm) connected between J3 and the monitor point, and between J4 and the monitor point, establish each sweep sample source impedance at approximately 50 ohms. One sweep sample output is routed to the M4E-2 module. The other signal is provided for the IF Marker module M13H.

3.9 CW SOURCE (MODULE M3E-2)

CW Source module M3E-2 contains the six crystal-controlled CW sources that provide markers for the low band VHF TV channels and IF.

The crystal oscillators (transistors Q1A through Q1E) are tuned-Colpitts types with the crystal operating at its third overtone frequency in series resonant mode. The tuning suppresses the crystal fundamental and higher-order resonant frequencies.

The crystal oscillator output signal for IF (channel 1) is coupled directly to the CW output jack, J1. The crystal oscillator signals for channels 2 through 6 are capacitively coupled to the emitters of common base configured transistors Q2A through Q2E. C10A through C10E and L4A-L4E in the collector loads are tuned to parallel resonance at the second harmonics of the crystal oscillators. C11A through C11E couple the doubled oscillator outputs to the CW output jack, where they are then fed to the second mixer of the M4E-2 RF Marker module. The CW sources are switched on one at a time by the channel program switch, applying B+ voltage to C6A-C6E.

3.10 RF CARRIER MARKERS (MODULE M4E-2)

The M4E-2 Marker Module contains an FET mixer, a low pass filter, an RF amplifier, a diode mixer, a crystal oscillator, a 2.25 MHz tuned amplifier circuit, a pulse detector amplifier, an AGC circuit, and an output pulse amplifier.

MOS FET mixer Q1 accepts a leveled and standardized sweep sample from the M3E-1 module at connector J1, and, when either the CATV or the high band VHF TV channels are selected, also accepts a center frequency CW signal from the M3E-1 module at J2. The LC filter, consisting of capacitors C4 through C8 and chokes L1, L2, and L3 in the drain load, attenuates the fundamental and product signals, and passes the difference signals. In IF and

the low band VHF TV channels 2 to 6, Q1 serves as a sweep sample amplifier.

The filtered output of Q1 is fed to the base of RF amplifier Q2, and then to diode mixer CR1. In the low band channels, a center frequency CW signal is also fed to the diode mixer from the M3E-2 module through J3. The resultant heterodyned signal is coupled through L7 and C17 to one gate of the tuned amplifier, Q5. C18 couples a sample of this signal to pin 1 for use by the M6P Marker module when additional RF markers are required.

When programmed to the high band VHF TV and the CATV channels, crystal oscillator Q4 and harmonic generator Q3 are activated by B+ applied to pin 9. The crystal oscillator is a tuned-Colpitts type with the crystal operating at its third overtone frequency in series resonant mode, tuned to suppress the crystal fundamental and higher order resonant frequencies.

The MOS FET amplifier, Q5, is tuned to 2.25 MHz by parallel-resonant tank L6/C16 at one gate, and by L12 and C30 in the drain load. The RF burst is amplified by Q6 and Q7, demodulated, and amplified to saturation by Q8. Operational amplifier IC1 amplifies the pulse response. Monitor circuit CR5 and C40 automatically adjusts the gain of tuned amplifier Q5 by regulating the bias on the second gate. This AGC keeps the pulse markers at the same level of saturation throughout the range of the instrument.

Transistor stages Q9, Q10, Q11, and Q12 further develop the signal to fast-rising negative-going pulses at pin 7. Pin 12 provides the B- voltage to be used by the additional RF marker module (**Option A-73, module M6P**) and also accepts the marker pulses from the M6P module when it is provided.

3.10.1 ADDITIONAL RF MARKERS (OPTION A-73)

When additional RF markers are required at each channel, the instrument is wired to accept an M6P Marker module containing a MOS FET amplifier tuned to the difference between the required marker frequency and the channel center frequency, and the same type of detector, AGC, and pulse amplifier circuits used in the M4E-2 module.

In the M4E-2 module, the heterodyned video from the diode mixer is fed through pin 1 to pin 2 of the M6P, where it is applied to a gate of Q1.

MOS FET Amplifier Q1 is tuned by parallel-resonant tank L1/C3 at one gate and by L2 and C8 in the drain load. The output response is demodulated and amplified by Q2 and Q3, and amplified to saturation by Q4. Operational amplifier IC1 amplifies the pulse response, and monitor circuit CR2/C5 automatically adjusts the gain of the tuned amplifier, Q1, by regulating the bias on the second gate. This AGC keeps the pulse markers at the same level

of saturation throughout the range of the instrument.

Transistor stages Q5, Q6, and Q7 further develop the signal to fast-rising pulses applied to pin 3 where it is fed to the M4E-2 module, pin 12. The B- voltage required to operate the M6P module is provided through pin 12 of the M4E-2 to pin 3 of the M6P.

3.11 IF MARKERS (OPTION A-71)

This option (module M13J-1) contains a sweep sample amplifier, five crystal filter circuits, comparators and transistor switches, and a common output pulse amplifier. A blanking circuit turns the markers off during retrace.

The sweep sample amplifier consists of Q1 and Q9. The collector load of the amplifier, RF transformer T1, is coupled to match the input impedance of the crystal filter circuits.

The crystal filters are very high "Q" resonant circuits developing sharp bursts of RF energy at their series-resonant frequencies. These bursts of RF are detected by CR1 through CR5 and applied to the non-inverting inputs of comparators IC1A through IC3A, which convert the small outputs from the crystal filters to DC voltage pulses. When B+ is supplied from the proper IF MARKER switch, the amplified pulses pass through transistor switches Q2 through Q6 to the common pulse amplifier, Q8.

The sharp, negative-going pulses are then routed to the marker adder circuits in the M8 module.

The marker blanking circuit, IC3B, turns the comparators off during retrace time by applying ~ 14 V to the inverting inputs during retrace.

3.12 IF CONVERSION L.O. TRACKING (OPTION B)

This option (module M7E) contains a conversion circuit consisting of a bandpass filter, RF amplifier, local oscillator, mixer, 10 to 20 MHz IF amplifier, and IF transformer. It also contains an automatic gain control (AGC) circuit, three crystal filters and their associated pulse preamplifier stages, a common marker pulse amplifier, and a reference pulse amplifier.

The input to the M7E is a sample of the swept IF signal from the tuner being tested by the sweep generator. One output is a pair of pulses which correspond to the points in time when the tuner IF output sweeps through the video and sound frequencies. The second output is a pulse midway between the frequencies of the other two.

CONVERSION CIRCUIT

The bandpass filter consists of the L/C tuned networks at the input to MOS FET Q1. The filter passes the frequency band from 30 to 50 MHz. Q1 is an amplifier that couples the IF frequencies to one input of mixer Q3. The other input receives the 55.75 MHz signal from crystal-controlled Colpitts oscillator, Q2. The AGC voltage is also applied to the mixer at this point. The 55.75 MHz local oscillator heterodynes with the output of Q1 to provide output frequencies of approximately 8 to 21 MHz. After conversion, 10 MHz corresponds to 45.75 MHz input, 12.25 MHz corresponds to 43.5 MHz, and 14.5 MHz corresponds to 41.25 MHz.

Mixer Q3 and MOS FET amplifier Q4 drive stagger-tuned Pi-networks to provide the required flat response. Frequencies below 10 MHz are attenuated by choke L8. Frequencies above the desired band are attenuated by the low-pass filtering of the Pi-networks.

AGC CIRCUIT

A sample of the signal level is coupled from the collector of Q6 to the AGC circuit consisting of monitor diode CR2 and integrated circuit IC1.

CRYSTAL FILTERS AND PULSE PREAMPLIFIERS

The secondary of T1 is center tapped to provide two opposite-phase signals to each of the three crystal filters. The crystal filter outputs are nulled for zero output, except at resonance, by variable capacitors C30, C32, and C34. These crystal filters provide sharp bursts of energy at their series-resonant frequencies. In each case, the crystal in the filter is selected to produce a frequency equal to the difference between the M7E local oscillator (55.75 MHz) and the desired marker. (For U.S. standard sound and video, these are: $55.75 - 41.25 = 14.5$ MHz, and $55.75 - 45.75 = 10$ MHz.) The RF bursts are detected by CR3 and amplified by Q7. Emitter follower Q8 provides a low impedance to drive amplifier Q9, providing sharp pulse inputs to the common pulse marker amplifier, Q10 and Q11.

REFERENCE PULSE AMPLIFIER

A second output from Q8B drives the reference pulse amplifier. The first stage, CR5 and Q12, duplicates the function of CR4 and Q9, as described above. The second stage, Q13, amplifies and inverts the pulse.

3.13 AUTOMATIC LEVEL AND SCOPE INDICATORS (OPTION C)

This option (module M8E) provides adjustable 40 dB gain

to the demodulated input from the front panel, selectable polarity circuits, and an RC network for adding markers to this demodulated signal. It primarily provides an automatic RF level (attenuation) DC voltage to the M10GA level control input, automatically adjusting the RF output level for a constant-amplitude demodulated tuner response. The module also provides oscilloscope indications of the RF level program by means of a vertical pedestal (pulse) on the retrace base line whose amplitude varies directly with the RF level program amplitude, and of the frequency (tuning) program by means of a narrow differentiated pulse that moves across the base line in ascending frequency from left to right.

DEMODULATED INPUT AMPLIFIER, INVERTER, AND MARKER ADDER

The demodulated response of the tuner under test is fed from the DEMOD INPUT jack to pin 8 and is AC coupled to FET source follower Q1, then to IC1A. Diodes CR1 and CR2 and divider network R8 through R11 provide input gate protection. The Var Gain potentiometer in the feedback network adjusts the amplifier gain. The output signal is applied to the low gain (x1) contact of switch S1 and to IC1B, which is set for a ten to one voltage gain (20 dB). The 20 dB Gain adjustments are provided so that automatic RF level programming may be used with both high and low level tuners without using external active DC probes. The signal at the common contact of the Gain x 10 switch, S1, is capacitively coupled to transistor Q4, then to IC2A. Q5, which saturates when the positive blanking square wave is applied to its base, is provided to restore DC level, and Bal control R14 adjusts for a zero volt baseline. The output signal is applied to the (inverted) contact of Polarity switch S2 and to the inverting input of IC2B, which is set for a gain of -1. The inverted signal is fed to the (normal) contact of the Polarity switch. A positive response pattern is selected for the proper operation of the Automatic Level circuits. (The high gain, wide range, and selectable-polarity circuits just described are provided so that responses of various DC levels may be brought within the operating range of the auto level circuitry, and permit the use of detectors of either polarity in the test set-up without requiring the use of external polarity-inverting amplifiers.)

The signal at the common contact of the Polarity switch is fed through R27 and pin 9 to the front-panel SCOPE VERT jack. Markers from pin 7 are combined with the output signal through C5.

AUTOMATIC LEVEL PROGRAM CIRCUITRY

The Auto Level feature senses the demodulated peak response at each sweep cycle, compares it to a pre-set reference voltage, and regulates the program voltage to the 20 dB PIN diode attenuator in the M10GA so as to maintain

the tuner response at a one volt level. This function is implemented by two sequential time-related pulses. The first is a sampling pulse occurring during the first half of retrace time, the second is a discharge pulse which occupies the remaining half of the retrace cycle.

The peak level of the demodulated response is detected by diode CR6 and capacitor C22. The RF blanking square wave, at pin 10, is level-shifted to near-symmetry about ground through Q8. The triangle wave at pin 4 is applied to the non-inverting input of the comparator IC4A, producing a positive square wave in the half cycle when the triangle wave is positive with respect to ground, i.e., the last half of the trace cycle and the first half of retrace. When both the signal at the collector of Q8 and at the output of IC4A are positive, diodes CR4 and CR5 do not conduct. The voltage at their anodes is then pulled up through R59, producing a positive pulse during the first half of retrace. This pulse, by turning FET switch Q11 on, transfers the voltage on C22 to C23, which is connected to the error amplifier consisting of Q12, Q13, and IC7A. C23 holds the voltage for the duration of the sweep cycle. The output of IC7A is connected to a follower consisting of Q16, Q17, and IC7B.

The output of IC7B is fed through zener diode CR8 to the base of emitter follower Q18. Since this program voltage will vary between -18 and 0 volts, Q18 is supplied from -30 volts. The 1 kohm resistor (R88) in series with the collector provides current overload protection.

When the demodulated output voltage exceeds 1.25 volts, the response at the common of S2 causes common base transistors Q14 and Q15 to conduct, turning on FET switch Q19. This inserts R84 into the IC7B feedback loop, increasing the feedback to quickly adjust the automatic level program.

During the last half of the retrace cycle, Q9 is turned on. FET switch Q10 discharges peak-detector capacitor C22 so that the detector network is reset for the next sweep cycle.

RF LEVEL INDICATOR PULSE CIRCUITRY

The RF Level Program is fed to pin 6 and applied to the inverting input of operational amplifier IC3B, which converts the -18 to 0 volt RF level program to a +1 to 0 volt program when it is combined with the demodulated output signal at the junction of R27 and pin 9.

The RF-blanking square wave from pin 10 is differentiated by capacitor C8 and resistor R32, and is applied to the base of transistor Q6. Q6 inverts and amplifies the positive leading spike derived from the start of retrace (RF "off" time). The negative-going pulse output from the collector of Q6 is differentiated by C9 and R34. The negative-going

leading spike is used to trigger the timer, IC5. This trigger sets a multivibrator which releases a short circuit around capacitor C10. C10 charges to a positive voltage at an exponential rate determined by the RC time constant of the capacitor and R35. When C10 has charged to 2/3 of the timer's B+ supply voltage, the multivibrator resets, quickly discharging the capacitor. The timer output is less than ¼ volt positive before it is triggered and over 10 volts positive during the charging time of C10. The high positive voltage overrides the negative bias on the gate of FET switch Q7, turning it on. When Q7 conducts, the converted level-program voltage at R39, described earlier, is transferred to pin 9. The result is a vertical pedestal pulse on the retrace base line located at the extreme right hand side of the scope display. The pulse amplitude indicates the RF level program.

FREQUENCY INDICATOR PULSE CIRCUITRY

The tuning program at pin 6 is inverted by operational amplifier IC3A, and the inverted program fed to the non-inverting input of comparator IC4B, where it offsets the adjusted triangle wave from pin 4. Freq. Ind. Range control R47 adjusts the amplitude of the triangle waveform and Freq. Ind. Cent. control R43 adjusts the offset level at the comparison point. The comparator output is a positive pulse starting and terminating at the points in time when the adjusted offset triangle wave is greater than the zero volt reference.

The output of comparator IC4B is differentiated by C14 and R48. Diode CR3 removes the positive trace spike. The negative retrace spike triggers the timer, IC6, which functions in the same way as the level indicator pulse timer, IC5, described above. The RC time constant of C16 and R50 establishes the duration of the positive pulse output. The timer output pulse is differentiated by C18 and R52, and combined with the demodulated output through R54. Since the timer is triggered by the negative spike only, the frequency indicator appears only on the retrace base line as a narrow differentiated pulse that moves across the base line in step with the tuning program.

SECTION 4

MAINTENANCE

4.1 INTRODUCTION

This section provides information for testing, calibrating, and troubleshooting the Sweep Generator. The performance tests are designed for incoming inspection and periodic evaluation. If performance is not to specifications, refer to the calibration and troubleshooting sections.

4.2 SERVICE INFORMATION

4.2.1 DISASSEMBLY INFORMATION

Refer to Figure 4-1.

REMOVAL OF BOTTOM COVER - Remove the two rear feet (A) and lift cover off with a slight rear movement.

REMOVAL OF TOP COVER- Remove the single screw (B) from the top and lift off cover with a slight rear movement.

REMOVAL OF SIDE PANEL- Either side panel can be removed to provide better access by removing the four screws holding the side panel to the instrument. The front panel/module section can be removed from the Power Supply section by removing two screws holding the sections together and by disconnecting the electrical connectors between the two sections.

NOTE

Separation of the two sections performs no useful purpose during normal service procedures.

4.2.2 MODULE SERVICING

SERVICE KIT K102 - This kit contains a module extender and RF extension cables which enable a module to be electrically operated while physically located above the rest of the modules, thereby making all parts easily accessible.

REMOVAL OF MODULE - Modules may be removed by removing any cables attached to the top of the module and removing the hold-down screw (C) from the bottom.

REMOVAL OF MODULE COVER - Remove all nuts and screws from top of module and slide the cover off.

REINSTALLING MODULE - Before reinstalling the module, check the module pins for proper alignment, then carefully seat the module pins into the chassis socket and replace the hold-down screw (C) to ensure a good ground connection between module and chassis.

MODULE PIN NUMBERING SYSTEM - The module pins are numbered as shown in Figure 4-2. The index studs for the circuit modules are located off center to prevent the module's being plugged in backwards. This off-center stud location also provides a method for locating pin 1.

4.2.3 TRANSISTOR LEAD CONFIGURATION

Transistor lead configurations are shown in Figure 4-3.

4.3 PERFORMANCE TESTS

4.3.1 INTRODUCTION

The purpose of the performance tests in this Section is to verify that the Model 1402A meets its published specifications (Section 1.2). Individual performance tests consist of the specification to be verified, a list of equipment required, and a detailed test procedure including, in some cases, a simplified setup drawing.

Before applying power to the instrument, see Section 2 for details of electrical installation. The line voltage should be maintained at 115 or 230 volts $\pm 10\%$, 50 or 60 Hz throughout the tests. The performance test procedures are begun after a 15 minute warmup of the instrument in $+20^{\circ}$ to $+30^{\circ}$ C ambient temperature.

A copy of the Performance Test Record (PTR) is provided at the end of this section for convenience in recording the performance of the Model 1402A during testing. It can be filled out and used as a permanent record for incoming inspection, or it can be used as a guide for routine performance testing. The PTR lists the section, test, specification and results.

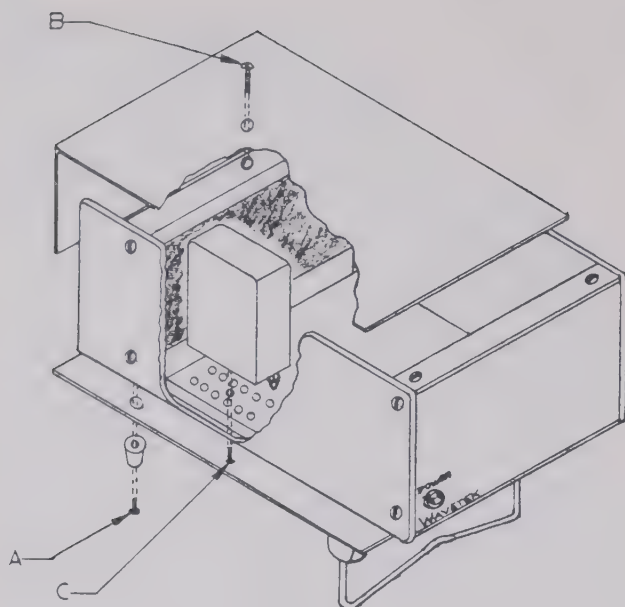


Figure 4-1. Disassembly

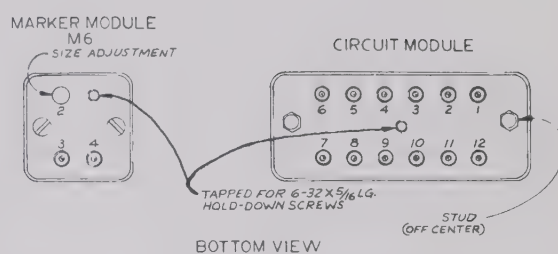


Figure 4-2. Module Pin Numbering

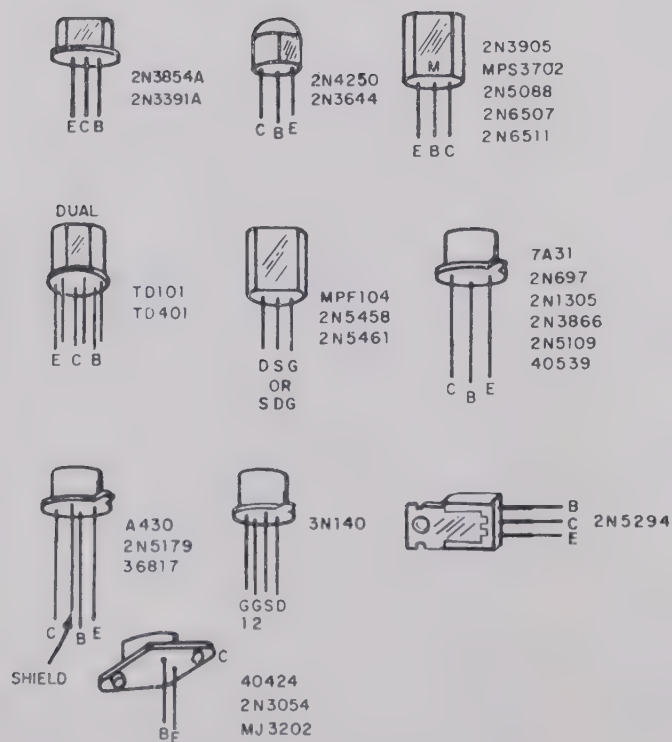


Figure 4-3. Transistor Configuration

RECOMMENDED TEST EQUIPMENT

INSTRUMENT	REQUIREMENT	RECOMMENDED
(1) 75 ohm RF Detector	1-400 MHz	Wavetek Model D171
(2) Oscilloscope	Horiz time base and X-Y operation	Tektronix T922
(3) Programming Fixture	-----	See Figure 4-4
(4) Marker Generator	1 MHz & 40 MHz	Wavetek Model SP298
(5) Signal Generator	Accuracy $\pm .001\%$ range 10-400 MHz resolution 10 kHz	Wavetek Model 3000
(6) Matching Pad	75 ohm-to-50 ohm BNC	Wavetek Model M175 (loss = 5.7 dB)
(7) Spectrum Analyzer	1-10 MHz	H. P. Model 182T Oscilloscope with Model 8558B Spectrum Analyzer plug-in head

4.3.2 SCOPE HORIZONTAL OUTPUT

SPECIFICATION -8 to $+8$ V triangle waveform, $\pm .2$ V.

EQUIPMENT (2)

PROCEDURE Connect the Model 1402A SCOPE HORIZ to the oscilloscope vertical input. Adjust the oscilloscope internal time base, vertical sensitivity, and triggering for a stable triangle waveform. Record the amplitude on the PTR. Note that the trace (positive slope) and retrace (negative slope) are each approximately 8.3 msec duration. This corresponds to a 60 Hz sweep rate (10 msec duration corresponds to a 50 Hz sweep rate).

4.3.3 DIAL ACCURACY

SPECIFICATION ± 1 MHz

EQUIPMENT (1) (2)

Because the CHANNEL switch is detented and every fifth channel is adjustable, dial inaccuracy is limited to the four in-between channels in each group of five. Connect Model 1402A as in Figure 4-5.

Reduce the sweep width so that the carrier marker pulses are 4.5 major divisions apart. The oscilloscope horizontal is now calibrated at 1 MHz per major division. Use the scope's horizontal position control to place one of the carrier markers exactly on a graticule line. Sequence through the channels and note the maximum deviation of the carrier marker from the graticule line.

4.3.4 MAXIMUM SWEEP WIDTH

SPECIFICATION 400 MHz

EQUIPMENT (1) (2) (4)

PROCEDURE Set the CHANNEL switch to 11 and connect the equipment as in Figure 4-6. Turn on the 40 MHz harmonic markers. Attenuate the RF ~ 15 dB to eliminate marker distortion. Identify the 0 MHz (zero beat) and 400 MHz markers. Turn on the 1 MHz harmonic markers and record the maximum sweep width on the PTR.

4.3.5 LINEARITY

SPECIFICATION $\pm 2\%$

EQUIPMENT (1) (2) (3)

PROCEDURE Connect the equipment as in Figure 4-6. Set the sweep width to maximum. Use the oscilloscope's horizontal position and horizontal gain controls to place the 0 MHz marker on the leftmost graticule line and the 400 MHz marker on the rightmost graticule line. Each 40 MHz marker should fall within 0.2 major division of a graticule line. Record the maximum deviation.

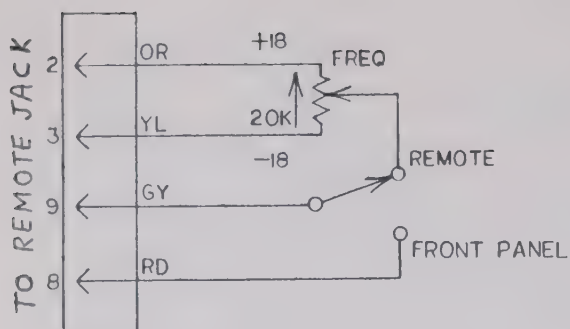


Figure 4-4. Programming Fixture

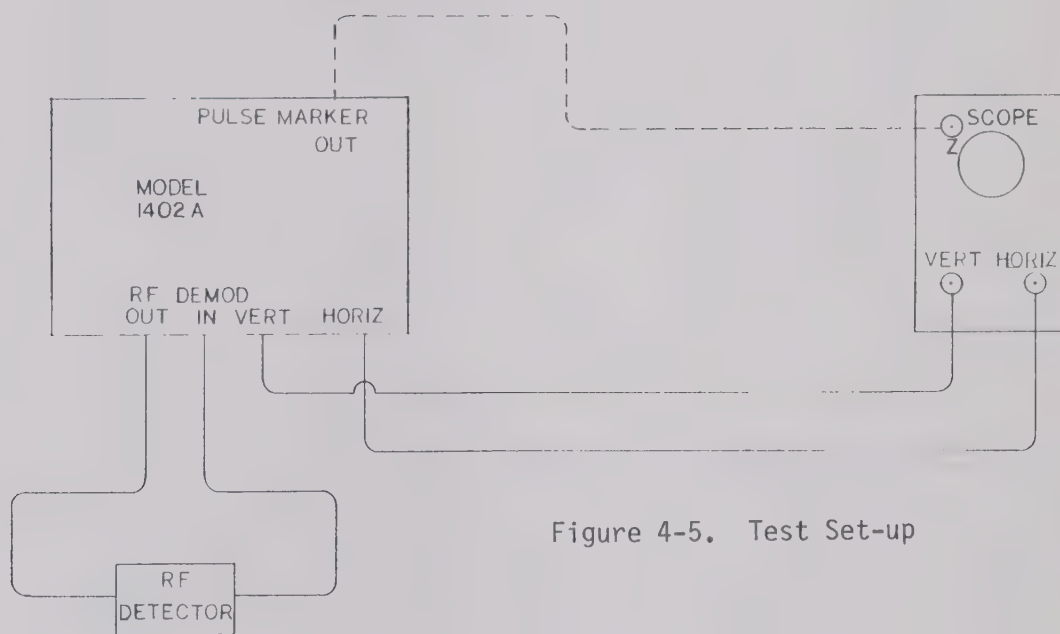


Figure 4-5. Test Set-up

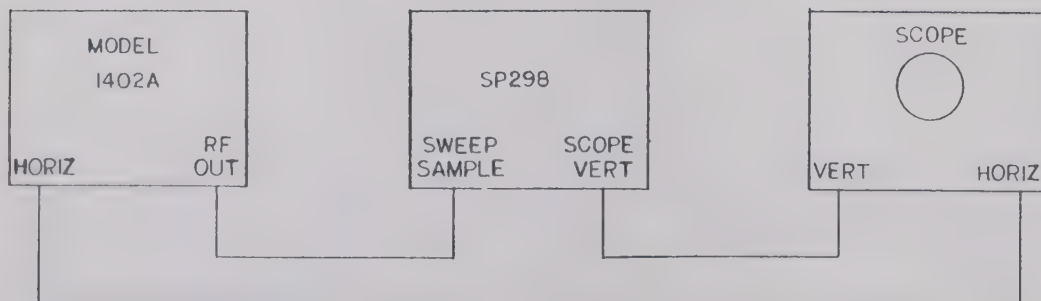


Figure 4-6. Test Set-up

4.3.6 MINIMUM SWEEP WIDTH

SPECIFICATION 10 MHz at wide minimum and 1 MHz at narrow minimum.

EQUIPMENT (1) (2) (4)

PROCEDURE The wide minimum sweep width can be checked with only an oscilloscope and RF detector; however, a marker generator is recommended for checking wide minimum and is necessary for checking narrow minimum sweep width.

To check wide minimum sweep width with an oscilloscope, set up as in Figure 4-5. Reduce the sweep width to minimum. Using the carrier marker separation of 4.5 MHz for calibration, determine the wide minimum sweep width.

To check wide minimum sweep width with a marker generator, set up as in Figure 4-6. Turn on the 1 MHz harmonic markers. Reduce the sweep width to minimum. Record the wide minimum sweep width.

Pull the SWEEP WIDTH knob out for narrow minimum sweep width. Record the narrow minimum sweep width.

4.3.7 TUNING RANGE

SPECIFICATION 1-400 MHz

EQUIPMENT (1) (2) (3) (4)

PROCEDURE Since the Model 1402A tuning control (CHANNEL switch) is detented at the TV channels, tuning range is only meaningful, and can only be checked, with a programming fixture. Remove REMOTE plug P101. Connect the programming fixture to REMOTE jack J101. Set the remote/front panel switch to "Remote". Tune the programming fixture's Frequency control and record the tuning range.

4.3.8 MAXIMUM OUTPUT

SPECIFICATION $>+57$ dBmV (0.708 VRMS).

EQUIPMENT (1) (2)

PROCEDURE Set up as in Figure 4-5. Set the STEP ATTENUATOR to 0, the CHANNEL switch to 11, and the SWEEP WIDTH control full cw. +57 dBmV is indicated by an RF detector output of approximately 0.8 VDC.

NOTE

RF detector characteristics limit the resolution of this method to ± 0.5 dB. If greater resolution is desired, a spectrum analyzer or power meter can be used with a matching pad to measure RF output power.

4.3.9 IMPEDANCE

SPECIFICATION 75 ohms $\pm 1\%$

EQUIPMENT (1) (2)

PROCEDURE Set up as in Figure 4-5. Insert a BNC "T" at the Model 1402A RF OUT connector. Note the detected output.

Add a 75 ohm termination to the open port of the BNC "T". The detected output should drop to 2/3 the previous value.

NOTE

Because of RF detector characteristics, etc., the resolution of this method is approximately $\pm 3\%$; however, this resolution should be adequate for most applications.

4.3.10 FLATNESS

SPECIFICATION $\pm .25$ dB over the entire band (1-400 MHz)

EQUIPMENT (1) (2)

PROCEDURE Set up as in Figure 4-5. Set the STEP ATTENUATOR to 0, the CHANNEL switch to 11, and SWEEP WIDTH control full cw. Note the maximum output peak on the scope. The flatness specification of $\pm .25$ dB corresponds to an output droop of less than 6% below the maximum output peak.

4.3.11 ATTENUATION

NOTE

There are two attenuators in the RF output path of the Model 1402A. The VERNIER ATTENUATOR is continuously adjustable from 0 dB to 20 dB, but is not calibrated. The fixed-pad 35 dB STEP ATTENUATOR is calibrated every 5 dB.

SPECIFICATION $\pm .5$ dB at any frequency from 1 to 400 MHz.

EQUIPMENT (6) (7)

PROCEDURE Set up as in Figure 4-7. Set the CHANNEL switch as desired. Turn AUTO LEVEL off. Set the VERNIER ATTENUATOR full cw. Set the SWEEP WIDTH control full ccw and pull for narrow. Set the trigger on the spectrum analyzer for line. Sequence through the Attenuator steps and record the maximum deviation from the nominal output.

Turn the VERNIER ATTENUATOR full ccw and record the range.

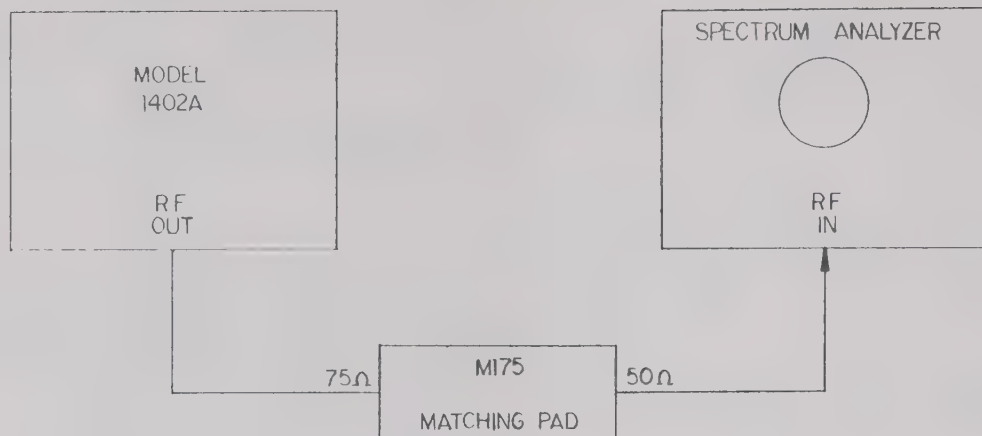


Figure 4-7. Test Set-up.

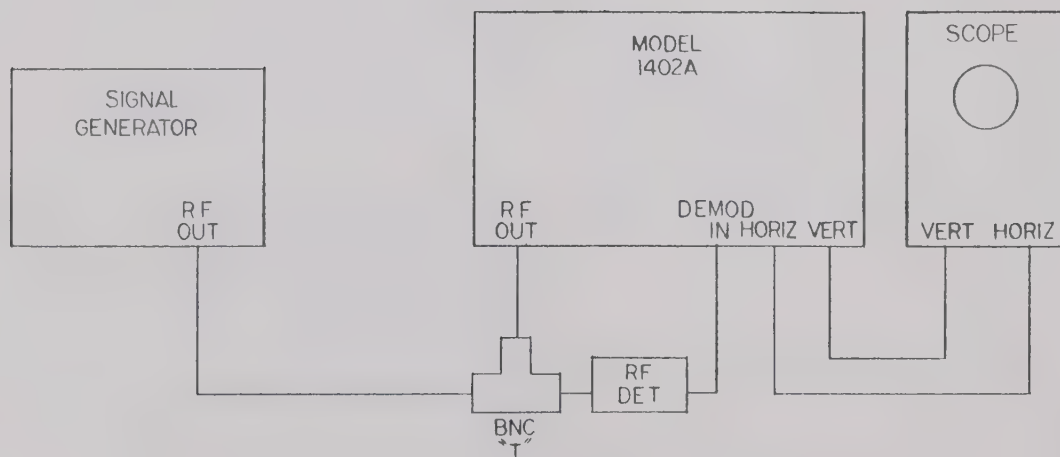


Figure 4-8. Test Set-up

4.3.12 MARKERS

SPECIFICATIONS

PRESENTATION differentiated pulses at SCOPE VERT connector.

Positive or negative pulses at PULSE MARKER OUTPUT connector.

SIZE 0 to 8 Vpp at SCOPE VERT connector

0 to ± 30 V at PULSE MARKER OUTPUT connector.

WIDTH approximately 1% of horizontal display

ACCURACY $\pm 0.02\%$ (+25 kHz-0 Hz) at pulse leading edge.

EQUIPMENT (2) (5)

PROCEDURE Set up as in Figure 4-5. Identify the differentiated carrier marker pulses. Rotate the MARKER SIZE control and record the range of pulse amplitude.

To route the carrier marker pulses to the rear-panel PULSE MARKER OUTPUT connector, install a jumper wire on the chassis at the M7E socket, pins 5 and 6.

Connect the oscilloscope's vertical input to the Model 1402A's PULSE MARKER OUTPUT connector. Identify the uni-polar marker pulses. Rotate the rear-panel PULSE MARKER SIZE control and record the range of the pulse amplitude. Throw the PULSE MARKER switch. Again rotate the rear-panel PULSE MARKER SIZE control and record the range of the pulse amplitude.

Remove the jumper and reconnect the oscilloscope's vertical input to the SCOPE VERT connector. Calibrate the scope horizontal to 1 MHz/major division by reducing the sweep width until the carrier marker pulses are 4.5 major divisions apart. Note that the carrier marker pulses are less than .1 major divisions wide.

Set up as in Figure 4-8. Set the Model 1402A to the desired channel. Set the sweep width to 10 MHz, and the signal generator for a -15 dBm CW signal.

Expand the scope horizontal by 10x for better resolution. Set the signal generator frequency so that the small RF-beat birdy is evenly divided by the leading edge of the carrier marker pulse.

Record the marker accuracy on the PTR.

NOTE

The resolution of this method is no better than ± 20 kHz, which is of the same order as the marker accuracy

specification; however, this resolution should be adequate for most applications.

4.4 CALIBRATION PROCEDURE

Remove the top covers from both the instrument and the M2E-1 module (each cover is retained by a single screw located on the top). Turn the instrument on and allow a 15 minute warm-up period before calibrating.

In general, calibration must be performed in the sequence given.

4.4.1 +18 VOLT ADJUSTMENT

Connect the digital voltmeter to the +18 volt supply (pin 6 on the power plug) and adjust R9 to produce +18 V ± 10 mV (see Figure 4-9).

4.4.2 -18 VOLT CHECK

Connect the digital voltmeter to the -18 volt supply (pin 4 on the power plug). The -18 volt supply is designed to track the +18 volt supply, and no independent adjustment is provided. The voltmeter should read -18 V ± 50 mV.

4.4.3 HORIZ SIZE ADJUSTMENT

Adjust the oscilloscope to operate in an X-Y mode with DC coupling on both the vertical and horizontal inputs. Adjust the oscilloscope's horizontal sensitivity to exactly 2 V/division (use the previously calibrated ± 18 volt supplies to calibrate the horizontal sensitivity). With no horizontal input to the oscilloscope, position the dot to the exact center of the display.

Connect the SCOPE HORIZ to the oscilloscope horizontal input. Adjust R26 (see Figure 4-9) to produce a horizontal line on the display of -8 to +8 volts as shown in Figure 4-10. An offset either way of .2 V is acceptable.

4.4.4 MODULE M2E-1 SIZE AND CENT ADJUSTMENTS

Set the CHANNEL switch to 11 and connect pin 5 of module M2E-1 to the oscilloscope vertical input. Adjust the Channel 13 control on the RS07 programmer (see Figure 4-16) for a 0.0 V ± 5 mV reading on the scope.

Using the set-up of Section 4.4.3, connect the oscilloscope vertical input to TP 1 in the M2E-1 module (see Figure 4-13). Set the SWEEP WIDTH control full cw. Set the oscilloscope's vertical sensitivity to 5 V/division and adjust M2E-1 Control B (Size) and Control A (Centering) to obtain a +14 to -14 volt signal centered about zero volts (see Figure 4-11).

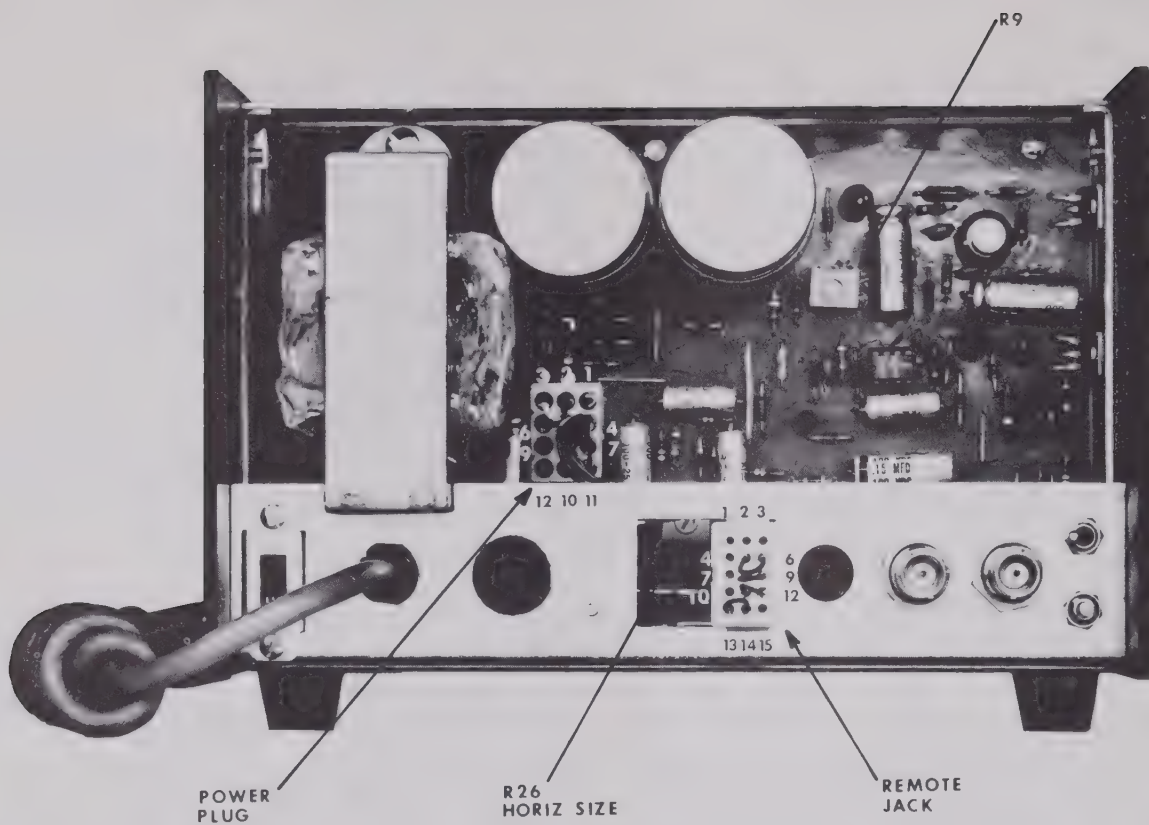


Figure 4-9. PS7 Rear View

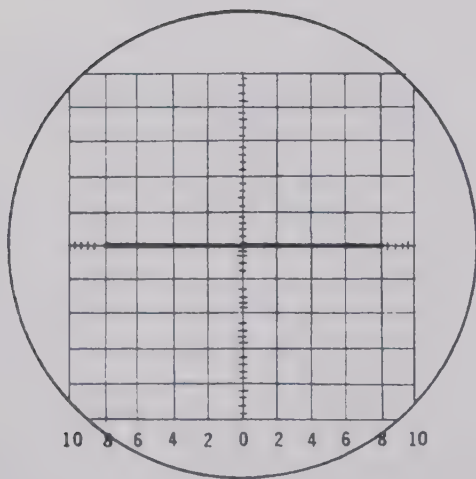


Figure 4-10. PS7 Horiz Size

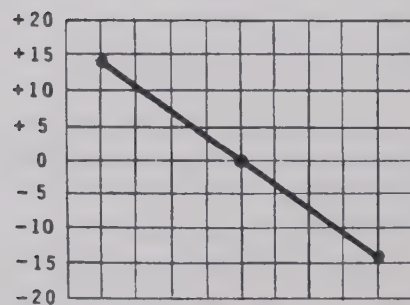


Figure 4-11. M2E-1 Size/Cent

4.4.5 MODULE M9L CENTERING ADJUSTMENT

Connect the equipment as shown in Figure 4-6. Set the oscilloscope's vertical sensitivity for .2 V/division and the oscilloscope's horizontal sensitivity for a display pattern 10 divisions wide. Set the STEP and VERNIER ATTENUATOR controls for maximum output (AUTO LEVEL off). Connect a Wavetek Model D171 RF Detector to the RF OUT connector and feed the output of the detector to the DEMOD IN connector of the instrument. Set sweep width to maximum and the CHANNEL switch to 11.

Turn on the 40 MHz harmonic markers. Set the fifth marker to the exact center of the display with the centering control on top of the M9L Oscillator module (see Figure 4-13).

4.4.6 MODULE M2E-1 SWEEP WIDTH ADJUSTMENT

Turn on the 40 MHz harmonic markers and adjust the Sweep Width limit control (see Figure 4-12) on the M2E-1 module to place the low frequency end-band marker 5% in from the extreme left scope graticule (see Figure 4-13).

4.4.7 MODULE M2E-1 LINEARITY REFERENCE

Keeping the center frequency marker in the center of the display, increase the oscilloscope's horizontal sensitivity to place the low frequency marker on the extreme left scope graticule.

Connect the scope vertical input to TP 2 of the M2E-1 module (see Figure 4-12) and adjust Control C (Linearity Reference) to position the knee just to the right of the 9th scope graticule as shown in Figure 4-14.

4.4.8 MODULE M2E-1 LINEARITY ADJUSTMENT

Leaving all the other settings and connections as in Section 4.4.7, reconnect the scope vertical to the instrument SCOPE VERT connector. The M9L Sweep Oscillator is inherently linear from the low frequency end to the center frequency. Five adjustments are provided to improve the linearity from the center frequency to the high frequency end of the band.

40 MHz harmonic markers are used in setting the linearity. Control D (see Figure 4-12) is used to position the first marker to the right of the center frequency marker as shown in Figure 4-15. Control E adjusts the second marker to the right of center, F controls the 3rd marker, G the 4th, and H positions the high-frequency marker on the extreme right scope graticule. Adjustments must be made in the sequence given.

4.4.9 M10GA AMPLIFIER MODULE MIN AND MAX LEVEL ADJUSTMENT

With the instrument still set up and producing a scope pattern similar to that of Figure 4-15, adjust the Level Max control on the M10GA to produce a scope pattern amplitude of .8 volts when the front-panel VERNIER ATTENUATOR is set at 0 dB (this is equivalent to an output of .7 VRMS). Next, set the front-panel VERNIER ATTENUATOR control fully counterclockwise and adjust the Level Min control to produce a scope pattern of 40 millivolts. Some interaction exists between the Level Min and Max adjustments, so repeat the adjustments until the 40 millivolt to .8 volt range is obtained. The accuracy of the above procedure is dependent on the RF detector, which is generally adequate. If more accuracy is required, an RF power meter can be substituted for the detector.

4.4.10 MODULE M3E-1 SWEEP SAMPLE ADJUSTMENT

Connect a 50 Ω RF detector to one of the sweep sample output connectors on module M3E-1. Set the M3E-1 Sweep Sample Adj for a detected level of 30 mV.

4.4.11 CHANNEL SWITCH ADJUSTMENT

Connect the digital voltmeter to pin 5 of module M2E-1. With the controls located on top of switch assembly RS07, set the M2E-1 pin 5 voltages to exactly the values shown in Figure 4-16.

4.5 TROUBLESHOOTING

Effective troubleshooting requires a thorough understanding of the block diagram and circuit description located in Section 3 of this manual. The Performance Tests and Calibration Procedures in Section 4 will aid in localizing the trouble symptom to a particular module. Once this has been accomplished, the module can be replaced, or repaired with the aid of the proper schematic. In general, it is preferable to replace a defective module.

Equipment troubles are frequently due simply to improper control settings; therefore, before engaging in a troubleshooting procedure, be sure all front-panel controls are set in proper operating position. Refer to the Operating Instructions in Section 2 of this manual for complete explanation of each control's function along with typical operating instructions.

After verifying that the trouble is not improper setting of the controls or test setup, make a thorough visual inspection of the instrument for such obvious defects as loose or missing screws, broken wires, defective module-pin sockets, loose RF cables, and burned or broken components.

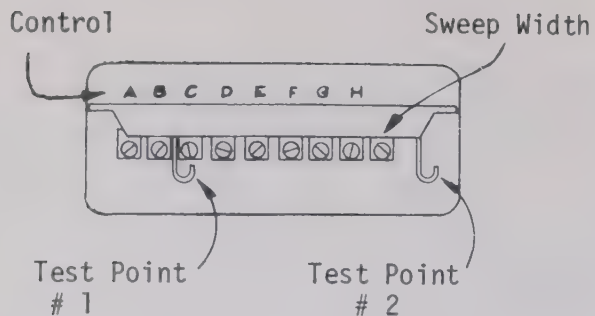


Figure 4-12. M2E-1 Control Locations

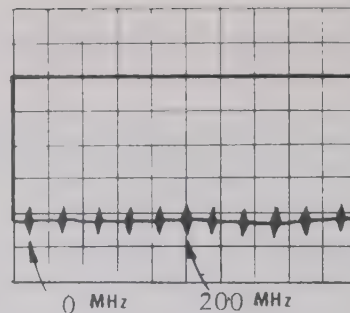


Figure 4-13. M2E-1 Sweep Width

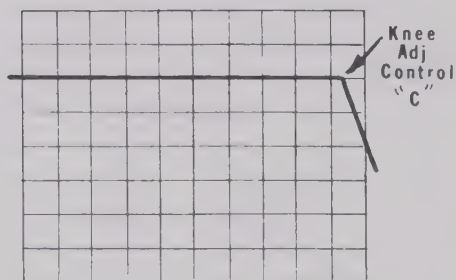


Figure 4-14. M2E-1 Lin Ref

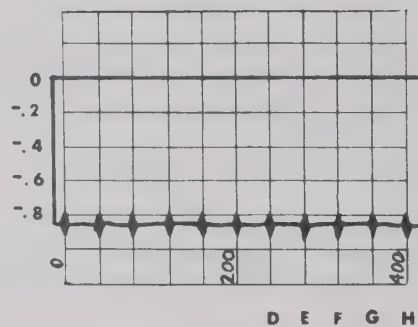
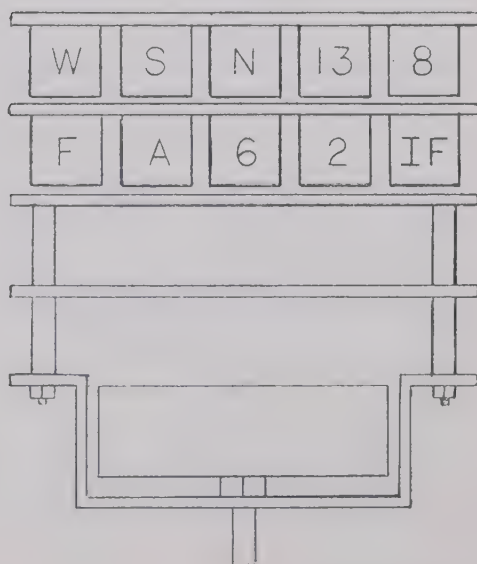


Figure 4-15. M2E-1 Linearity



CHAN	PGM VOLT
IF	-5.85
2	-5.32
6	-4.30
8	-0.66
13	+0.44
A	-2.88
F	-1.77
N	+1.55
S	+2.70
W	+3.58

Figure 4-16. RS07 Controls/Voltages

After localizing the problem, voltage and resistance checks will help find the defective component.

For troubleshooting purposes, it is permissible to operate the Model 1402A with any of the plug-in modules or RF cables removed; however, the instrument should be turned off when removing or installing modules. If substitute modules are available, possibly from another Model 1402A, this provides an easy method of verifying if a suspected module is defective.

RF cables can be disconnected from the module output connectors; then a power meter or spectrum analyzer can be connected directly to the module connector for power level or frequency measurements. Fabrication of a short coax adapter cable, terminated in a mating connector for the modules on one end and a BNC connector on the other, will facilitate connection of test equipment.

A problem in a power supply may cause many symptoms pointing to other areas, and should be checked when the symptom does not indicate a specific problem.

4.5.1 TROUBLESHOOTING HINTS

Following is a list of several typical symptoms, accompanied by the possible cause(s) or a troubleshooting procedure. It is assumed the instrument has been properly calibrated previously, and that a warmup period will precede troubleshooting.

+18 V OUT OF CALIBRATION — If the +18 V supply measures over +25 V, change the regulator, IC1. If the ± 18 V supplies measure low, disconnect the jack, J2, from the PS7 Power Supply and carefully check for ± 18 V at plug P2. If the ± 18 V supplies are now correct, low voltage was due to over-current limiting by the Power Supply. Reconnect J2 to P2 and unplug modules until the overload is found.

INTERMITTENT OPERATION — Check for loose RF cables or loose modules. If none, check for defective module pin sockets.

NO HORIZONTAL OUTPUT — Check pin 8 of Power Supply plug P2 for a ± 8 V triangle wave. If none, check the ± 18 V supplies.

NO RF OUTPUT — Use an RF detector to check the outputs of modules M10GA and M9L.

INCORRECT RF CENTER FREQUENCY — Check P102, pin 12 for the correct programming voltage (V_p) as indicated in Figure 2-12. If the programming voltage is incorrect, check P102, pins 13, 14, and 15, for correct supply voltages and ground to the RS07 switch assembly. If it is necessary to troubleshoot the RS07 sub-assembly, refer to the CHANNEL program switch circuit description, Section 3.4.

FREQUENCY INSTABILITY — Check hold-down screws beneath modules M2E-1 and M9L. Check for a stable sweep drive voltage from module M2E-1 at pin 9. Ensure that the ± 18 V supply voltages have less than 5 mV ripple.

UNFLAT RF OUTPUT — Check for a defective RF detector. Reduce the RF output with the VERNIER ATTENUATOR to see if the RF output notches flatten out. If they do not, check RF output cables. If they do, check module M9L for sufficient RF output (30 mV into a 50 ohm detector).

NO SCOPE VERT OUTPUT — Check for at least a 10 mV amplitude DC signal into the DEMOD IN connector. If present, the trouble is probably in module M8E (Option C).

UNSTABLE BASELINE — Check module M8 or M8E (Option C) for good ground.

NO MARKERS OR WEAK MARKERS — Check for sufficient sweep sample output from module M3E-1 (30 mV into 50 ohm detector). If not sufficient, check the sweep sample output from module M9L (typically 100 mV into a 50 ohm detector).

If the sweep sample is sufficient, and specific channel markers are missing, the trouble is probably in the corresponding Crystal Source oscillator.

If the markers activated for a specific channel appear to be one channel off frequency, check for a worn CHANNEL switch by rocking the CHANNEL switch detent to see if the correct markers will appear.

PERFORMANCE TEST RECORD

DATE _____

Model 1402A

S.N. _____

SECTION	TEST	SPECIFICATION	RESULTS
4.3.2	Scope Horizontal Output	-8 to +8 V, $\pm .2$ V	- _____ V to + _____ V
4.3.3	Dial Accuracy	± 1 MHz	_____ MHz
4.3.4	Maximum Sweep Width	>400 MHz	_____ MHz
4.3.5	Linearity	$\pm 2\%$	_____ %
4.3.6	Minimum Sweep Width		
	Wide	< 10 MHz	_____ MHz
	Narrow	< 1 MHz	_____ MHz
4.3.7	Tuning Range	< 1 to > 400 MHz	_____ MHz
4.3.8	Maximum Output	> .75 VDC	_____ VDC
4.3.9	Impedance	64 - 70%	_____ %
4.3.10	Flatness	< 6%	_____ %
4.3.13	Attenuation		
	Step	± 0.5 dB	_____ dB
	Vernier	20 ± 0.5 dB	_____ dB
4.3.14	Markers		
	Size		
	At Scope Vert	~ 0 V to > 8 V pp	_____ Vpp
	At Pulse Marker Out	~ 0 V to > ± 30 V	_____ V
	Width	$\sim 1\%$	_____ %
	Accuracy	$\pm .02\%$ (+25 KHz - 0 Hz)	_____ KHz

SECTION 5

REPLACEABLE PARTS

5.1 INTRODUCTION

This section contains lists of all replaceable parts for the instrument.

For an assembly containing one or more subassemblies, the assembly list appears first, and is followed by the subassembly lists.

The lists appear in the following order.

PARTS LIST	ASSEMBLY
1010-00-0066	1402A
1111-00-0015	CHASSIS - 1402A
1219-00-0049	HARNESS - 1402A
1118-00-0001	REMOTE PLUG - 1402A
1115-00-0005	PS7
1218-00-0013	PC - PS7
1112-00-0018	RS07
1219-10-0001	HARNESS - RS07
1114-00-0087	M2E-1
1114-00-0088	M3E-1
1114-00-0098	M3E-2
1114-00-0216	M4E-2
1114-00-0129	M6P
1114-00-0197	M7E
1114-00-0128	M8E
1114-00-0060	M9L
1114-00-0032	M10GA
1114-00-0318	M13J-1

5.2 MANUFACTURERS CODE

The following code is used on the parts lists to identify the manufacturer.

ABBRV	NAME.....	CITY.....	ST
A-B	ALLEN-BRADLEY	MILWAUKEE	WI
A-D	ANALOG DEVICES	CAMBRIDGE	MA
A-H	ARROW HART, INC.	KETTERING	OH
A-I	ALAN INDUSTRIES	COLUMBUS	IN
A-M	AMERICAN MAGNETICS	CARTERVILLE	IL
A-P	AMERICAN PLASTICRAFT CO.	CHICAGO	IL
ABAC	ABACUS PACKAGING CO.	CHICAGO	IL
ACI	ADVANCE COMPONENTS, INC.	CENTERBROOK	CT
AER	AVX CERAMICS	MYRTLE BEACH	SC
AERTK	AERTECH INDUSTRIES	SUNNYVALE	CA
AHAM	AHAM COMPANY	AZUSA	CA
AIN	ALPHA INDUSTRIES, INC.	WOBURN	MA
ALC	ALCO ELECTRONICS PRODUCTS	NORTH ANDOVER	ME
ALLPL	ALL PLASTICS, INC.	INDIANAPOLIS	IN
AMD	ADVANCED MICRO DEVICES INC.	SUNNYVALE	CA
AMD	ADVANCED MICRO DEVICES, INC.	SUNNYVALE	CA
AMP	AMP, INC.	HARRISBURG	PA
APL	AMPHENOL CONNECTOR SYSTEMS	BROADVIEW	IL
APX	AMPEREX ELECTRONIC CORP.	SLATERSVILLE	RI
ARC	ARCO ELECTRIC PRODUCTS	SHELBYVILLE	IN
ARN	ARNOLD ENGINEERING CO.	MARENGO	IL
ARW-M	ARROW-M CORP.	CARSON	CA
ASC	ASSOCIATED SPRING	BRISTOL	CT
ASE	AIRCO SPEER ELECTRONICS	ST. MARYS	PA
AT/IN	ATLANTIC INDIA RUBBER COMPANY	CHICAGO	IL
ATC	AMERICAN TECHNICAL CERAMICS	HUNTINGTON STATION	NY
ATR	ATR COIL CO.	BLOOMINGTON	IN
AUGAT	AUGAT, INC.	ATTLEBORO	MA
AULT	AULT INC.	MINNEAPOLIS	MN
AVT	AVANTEK, INC.	SANTA CLARA	CA
AWC	ALPHA WIRE	ELIZABETH	NJ
B-T	BEK-TEK, INC.	READING	PA
BEK	BECKMAN INSTRUMENTS, INC.	FULLERTON	CA
BEL	BELDEN CORP.	GENEVA	IL
BER	BERG ELECTRONICS	NEW CUMBERLAND	PA
BGH	BEECH GROVE HARDWARE	BEECH GROVE	IN
BOU	BOURNS, INC.	RIVERSIDE	CA
BREZ	BREEZE CORPORATIONS, INC.	UNION	NJ
BUCK	BUCKEYE STAMPING CO.	COLUMBUS	OH
BUD	BUD RADIO, INC.	WILLOUGHBY	OH
BURND	BURNDY CORP.	NORWALK	CT
BUS	BUSSMAN MFG.	ST. LOUIS	MO
BWC	BARON WIRE AND CABLE CORP.	NILES	IL
C-D	CORNELL DUBILIER ELECT. DIV.	NEWARK	NJ
C-E	CLINTON ELECTRONICS	ROCKFORD	IL
C-H	CUTLER-HAMMER, INC.	MILWAUKEE	WI
C-I	COMPONENTS, INC.	BIDDEFORD	ME
C-J	TRW/CINCH	ELK GROVE VILLAGE	IL
C-K	C & K COMPONENTS, INC.	WATERTOWN	MA
C-L	CENTRALAB DIV.	MILWAUKEE	WI
C-W	C-W INDUSTRIES	WARMINSTER	PA
CAI	CUSTOM ACCESSORIES, INC.	SKOKIE	IL
CAM	CAMBION	CAMBRIDGE	MA
CAR	CARLING ELECTRIC, INC.	WEST HARTFORD	CT
CCM	CORCOM, INC.	CHICAGO	IL
CDC	COMPONENT DEVELOPMENT CORP.	CARSON	CA

ABBRV	NAME.....	CITY.....	ST
CECO	CENTRAL COIL CO.	BRAZIL	IN
CGW	CORNING GLASS WORKS	CORNING	NY
CHE	CHERRY ELECTRICAL PRODUCTS	WAUKEGAN	IL
CHOM	CHOMERICS INC.	WOBURN	MA
CIMCO	CIMCO WIRE AND CABLE INC.	ALLENDALE	NJ
CKI	CTS KNIGHTS, INC.	SANDWICH	IL
CLA	CLAIREX CORP.	MT. VERNON	NY
CLAR	CLAROSTAT MFG. CO	DOVER	NH
CLFX	COLE-FLEX CORP.	BABYLON	NY
CPKG	CREATIVE PACKAGING DIV.	INDIANAPOLIS	IN
CTS	CHICAGO TELEPHONE SYSTEMS	CHICAGO	IL
CTS-E	CTS OF ELKHART	ELKHART	IN
CTSB	CTS OF BERNE	BERNE	IN
CTSBV	CTS OF BROWNSVILLE	BROWNSVILLE	TX
DAL	DALE TECHNOLOGY CORP.	HARTSDALE	NY
DAV	HARRY DAVIES MOLDING CO.	CHICAGO	IL
DEL	DELEVAN DIV.	EAST AURORA	NY
DEN	DENNISON MFG. CO.	FRAMINGHAM	MA
DEW	DEWIRE FABRICATING CORP.	LOWELL	MA
DIO	DIODES, INC.	CHATSWORTH	CA
DRA	DRAKE MANUFACTURING CO.	HARWOOD HEIGHTS	IL
E-C	ELECTRONIC CRYSTALS	KANSAS CITY	MO
E-M	ELECTRA/MIDLAND CORP.	MINERAL WELLS	TX
ECMC	ELECTRI-CORD MFG. CO. INC.	WESTFIELD	PA
ELCO	ELCO INDUSTRIES	ROCKFORD	IL
ELFX	ELECTRO-FLEX HEAT INC.	BLOOMFIELD	CT
EPITK	EPITEK ELECTRONICS	KANATA, ONT., CAN.	**
ETP	ERIE TECHNOLOGICAL PRODUCTS	ERIE	PA
EXAR	EXAR INTEGRATED SYSTEMS	SUNNYVALE	CA
F-K	THERMWELL PRODUCTS, INC.	FRAMINGHAM	MA
F-S	FEDERAL SCREW	CHICAGO	IL
FAN	FANCOURT & CO.	GREENSBORO	NC
FCD	FAIRCHILD	MOUNTAIN VIEW	CA
FRK	FRAKO	FRANKFORT, GER.	**
FRTE	FAIR RITE PRODUCTS CORP.	WALLKILL	NY
FRXC	FERROXCUBE DIVISION	SAUGERTIES	NY
G-E	GENERAL ELECTRIC	INDIANAPOLIS	IN
G-H	GRAYHILL, INC.	LA GRANGE	IL
G-I	GEN'L INSTRUMENT SEMICONDUCTOR	HICKSVILLE	NY
GAL	GALILEO ELECTRO-OPTICS	CARMEL	IN
GATES	GATES ENERGY PROD.	DENVER	CO
GBN	GILBERT ENGINEERING CO. INC.	PHOENIX	AZ
GOV	GOULD, INC.	ST. PAUL	MN
GRIES	GRIES REPRODUCER	NEW ROCHELLE	NY
GRIP	GRIPMASTER CO.	MARLBORO	NJ
GUDL	GUDEBROD BROS. SILK CO.	CHICAGO	IL
H-P	HEWLETT-PACKARD	INDIANAPOLIS	IN
HEL	HELIPOT	ANAHEIM	CA
HEY	HEYMAN MFG. CO.	WAUKESHA	WI
HHS	HERMAN H. SMITH, INC.	BROOKLYN	NY
HIT	HITACHI AMERICA, LTD.	SAN FRANCISCO	CA
HOLUB	HOLUB DISTRIBUTING CO.	NEWPORT	KY
HUD	HUDSON TOOL & DIE CO.	NEWARK	NJ
HY/PL	HYDRO PLASTICS INC.	GEORGETOWN	KY
HYT	HYTRONICS	PINELLAS PARK	FL
ICI	ILLINOIS CAPACITOR INC.	MORTON GROVE	IL

ABBRV	NAME.....	CITY.....	ST
IERC	INT'L ELEC. RESEARCH CORP.	BURBANK	CA
INT	INTERSIL, INC.	CUPERTINO	CA
IRC	INTERNATIONAL RESISTANCE CO.	PHILADELPHIA	PA
ITT	INT'L TELEPHONE & TELEGRAPH	W. PALM BEACH	FL
JAN	JAN HARDWARE MFG. CO.	LONG ISLAND CITY	NY
JEF	JEFFERS	DUBOIS	PA
JEFWC	JEFFERSON WIRE AND CABLE	WORCHESTER	MA
JEW	JEWELL ELECTRICAL INSTRUMENTS	MANCHESTER	NH
JHSN	JOHANSON MFG. CORP.	BOONTON	NJ
JON	E.F. JOHNSON CO.	WASECA	MN
JUDD	JUDD WIRE DIV. ECC	TURNERS FALLS	MA
K-L	KERRIGAN LEWIS MFG.	CHICAGO	IL
K-S	K & S ENGINEERING CO.	CHICAGO	IL
KEENE	KEENE CORP.	NEWARK	DE
KEM	KEMTRON ELECTRON PRODUCTS	NEWBURYPORT	MA
KEY	KEYSTONE ELECTRONIC CORP.	NEW YORK	NY
KID	KIDCO, INC.	MEDFORD	NJ
KIN	KINGS ELECTRONICS	TUCKAHOE	NY
KSTR	KESTER SOLDER DIV.	CHICAGO	IL
KSW	KSW ELECTRONICS	INDIANAPOLIS	IN
KUL	KULKA ELECTRIC CORP.	MT. VERNON	NY
LEYSE	LEYSE ALUMINUM CO.	KEWANEE	WI
LIT	LITTELFUSE, INC.	DES PLAINES	IL
LRC	LRC ELECTRONICS, INC.	HORNELL	NY
M-A	MICROWAVE ASSOCIATES	BURLINGTON	MA
M-D	MILLER DIAL & NAMEPLATE CO.	EL MONTE	CA
M-E	MEPCO ELECTRA, INC.	MORRISTOWN	NJ
M-O	ILLUMINATED PRODUCTS INC.	SANTA ANA	CA
M-P	MICRO PLASTICS INC.	CHATSWORTH	CA
MAL	MALLORY CONTROLS CO.	FRANKFORT	IN
MAND	MANDEX	CHICAGO	IL
MARQ	J. & J. MARQUARDT	TUTTLINGEN, GER.	**
MDC	MAIDA DEVELOPMENT CO.	HAMPTON	VA
MILN	MILLEN MFG. CO.	NEW YORK	NY
MILSP	MILITARY SPECIFICATION	WASHINGTON	DC
MINOR	MINOR RUBBER CO.	BLOOMFIELD	NJ
MMM	3M COMPANY	ST. PAUL	MN
MNO	MONSANTO COMM. PROD. DIV.	PALO ALTO	CA
MOL	MOLEX PRODUCTS	LISLE	IL
MOT	MOTOROLA SEMI. PROD. DIV.	INDIANAPOLIS	IN
MRO	MICRO SWITCH DIV.	FREEPORT	IL
MSN	MICROSONICS DIV.	WEYMOUTH	MA
MSP	MICRO SEMICONDUCTOR CORP.	SANTA ANA	CA
MWS	MAGNET WIRE SUPPLY CO.	CHATSWORTH	CA
MYERS	MYERS SPRING CO.	LOGANSPOET	IN
N-T	NATIONAL TEL-TRONICS	LAREDO	TX
NAT	NATIONAL SEMICONDUCTOR CORP.	SANTA CLARA	CA
NEC	NIPPON ELECTRIC CO.	TOKYO, JAPAN	**
NEL	NATIONAL ENGINEERING LABS	INDIANAPOLIS	IN
NEW	NEWARK ELECTRONICS	INDIANAPOLIS	IN
NYLO	NYLOMATIC	MORRISVILLE	PA
O-G	OPTI-GAGE INC.	DAYTON	OH
O-S	OMNI SPECTRA INC.	FARMINGTON	MI
OAK	OAK INDUSTRIES INC.	CRYSTAL LAKE	IL
OHM	OHMITE MFG. CO.	SKOKIE	IL
OMEGA	OMEGA WIRE & CABLE	HARLEYSVILLE	PA

ABBRV	NAME.....	CITY.....	ST
OPTRN	OPTRON INC.	CARROLLTON	TX
P-B	POTTER AND BRUMFIELD	PRINCETON	IN
P-C	POWER COMPONENTS	WOODLAND HILLS	CA
P-K	PARKER KALON CORP.	CLIFTON	NJ
P-T	PENN TUBE PLASTICS CO.	CLIFTON HEIGHTS	PA
P-U	PROJECTS UNLIMITED INC.	DAYTON	OH
PAM	PAMOTOR DIV.	BURLINGAME	CA
PAM	PAMOTOR DIV.	BURLINGAME	CA
PAND	PANDUIT CORP.	TINLEY PARK	IL
PARA	PARAMETRIC INDUSTRIES	NORTHFIELD	IL
PCC	PANEL COMPONENTS CORP.	BERKELEY	CA
PEC	PACIFIC ELECTRICORD CO.	GARDENA	CA
PHC	PHILADELPHIA HANDLE CO.	CAMDEN	NJ
PIC	PIHER INTERNATIONAL CORP.	ARLINGTON HEIGHTS	IL
PLSSY	PLESSEY ENG.	SCHILLER PARK	IL
PMCL	PERMACEL DIV.	NEW BRUNSWICK	NJ
PMI	PRECISION MONOLITHICS INC.	SANTA CLARA	CA
POM	POMONA ELECTRONICS CO., INC.	POMONA	CA
PRMD	PYRAMID INDUSTRIES, INC.	PHOENIX	AZ
PRSN	PRECISION TUBE CO., INC	NORTH WALES	PA
PTN	PENN TRAN CORP.	BELLEFONT	PA
PYRO	PYROFILM CORP.	WHIPPANY	NY
PYTT	PYTTRONICS INDUSTRIES, INC.	MONTGOMERYVILLE	PA
Q-C	QUALITY COMPONENTS	ST. MARYS	PA
RAY	RAYTHEON	INDIANAPOLIS	IN
RCA	RCA	CAMDEN	NJ
REL	RELIANCE MICA CO.	BROOKLYN	NY
RGR	ROGERS CORP.	CHANDLER	AZ
RICH	RICHCO PLASTIC CO.	CHICAGO	IL
RMC	RADIO MATERIALS CORP.	CHICAGO	IL
RMF	RMF PRODUCTS INC.	BATAVIA	IL
ROGAN	ROGAN CORP.	NORTHBROOK	IL
S-C	SPECIALTY CONNECTOR	INDIANAPOLIS	IN
S-G	STANDARD GRIGSBY	AURORA	IL
S-I	SWITCHCRAFT, INC.	CHICAGO	IL
S-S	SERVICE SUPPLY	INDIANAPOLIS	IN
S-T	SARKES TARZIAN	BLOOMINGTON	IN
SCBE	SCANBE DIVISION	EL MONTE	CA
SCC	STACKPOLE CARBON CO.	ST. MARYS	PA
SCX	SILICONIX INC.	SANTA CLARA	CA
SEAST	SEASTROM MFG. CO.	GLENDALE	CA
SEL	SEAELECTRO CORP.	MAMARONECK	NY
SEM	SEMTECH	NEWBURY PARK	CA
SGM	SIGMA INSTRUMENTS	BRAINTREE	MA
SHAM	SHAMROCK PLASTICS & RUBBER CO.	INDIANAPOLIS	IN
SIEM	SIEMENS	ISELIN	NJ
SIG	SIGNETICS CORPORATION	SUNNYVALE	CA
SLT	SOLITRON/MICROWAVE DIV.	PORT SALERNO	FL
SOUTH	SOUTHCO FASTENERS	LESTER	PA
SPE	SPECTROL	DAYTON	OH
SPEC	SPECTRUM CONTROL. INC.	FAIRVIEW	PA
SPR	SPRAGUE ELECTRIC CO.	INDIANAPOLIS	IN
SPST	SPECTRA-STRIP	GARDEN GROVE	CA
SSS	SOLID STATE SCIENTIFIC	MONTGOMERYVILLE	PA
STR	STETTNER TRUSH CO.	CAZENOVIA	NY
STSA	STEEL SALES	INDIANAPOLIS	IN

ABBRV	NAME.....	CITY.....	ST
SYL	GTE SYLVANIA	WALTHAM	MA
SYS	SYSCON INTERNATIONAL, INC.	SOUTH BEND	IN
T-I	TEXAS INSTRUMENTS	DALLAS	TX
TCPL	TACONIC PLASTIC	PETERSBURG	NY
TEK	TEKTRONIX	INDIANAPOLIS	IN
TEKA	TEKA PRODUCTS INC.	COLLEGE POINT	NY
TELE	TELETYPE CORP.	ELK GROVE VILLAGE	IL
THR	THERMALLOY CO.	DALLAS	TX
TIMES	TIMES WIRE AND CABLE	CINCINNAI	OH
TIN	TINNERMAN PRODUCTS, INC.	CLEVELAND	OH
TKN	TECHNICAL WIRE	CRAWFORD	NJ
TLNC	TELONIC ALTAIR	LAGUNA BEACH	CA
TORCO	TOR CORP.	VAN NUYS	CA
TRU	WALDES TRUARC	LONG ISLAND CITY	NY
TRW	TRW CAPACITOR DIV.	OGALLALA	NB
U-C	UNIVERSAL COMPONENTS	LOS ANGELES	CA
UNCAR	UNION CARBIDE COMPONENTS	GREENVILLE	SC
UNIC	UNICORP	ORANGE	NJ
UNIT	UNITRODE CORP.	WATERTOWN	MA
USECO	USECO DIV.	VAN NUYS	CA
UTK	UNITRACK DIV.	UPPER DARBY	PA
VAC	VACTEC INC.	MARYLAND HEIGHTS	MO
VACO	VACO PRODUCTS CO.	NORTHBROOK	IL
VAR	VARADYNE CAPACITOR DIV.	SANTA MONICA	CA
VARIL	VARI-L CO.	DENVER	CO
VLIER	VLIER ENGINEERING CORP.	BURBANK	CA
VONGT	VONNEGUT HARDWARE	INDIANAPOLIS	IN
VRN	VERNITRON CORP.	GREAT NECK	NY
VRN	VERNITRON CORP.	GREAT NECK	NY
W-E	WELLS ELECTRONICS	SOUTH BEND	IN
W-I	WAVETEK INDIANA, INC.	BEECH GROVE	IN
WAG	WAGNER ELECTRIC CORP.	ST. LOUIS	MO
WECK	WECKESSER CO., INC.	CHICAGO	IL
WKFLD	WAKEFIELD ENGINEERING	WAKEFIELD	MA
WNSL	WEINSCHEL ENGINEERING	GAITHERSBURG	MD
WSD	WAVETEK	SAN DIEGO	CA
WSR	WAVETEK	SANTA ROSA	CA
ZEN	ZENITH RADIO CORP.	CHICAGO	IL
ZERO	ZERO MANUFACTURING CO.	BURBANK	CA
ZIE	ZIERICK MFG. CORP.	MOUNT KISCO	NY
ZPT	ZIPPERTUBING, CO.	LOS ANGELES	CA

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	CHASSIS, 1402A	A500-269	W-I	1111-00-0015	1
2	POWER SWITCH ASSY A500-247	A500-247	W-I	1112-00-0002	1
14	POWER SUPPLY, PS7	PS7	W-I	1115-00-0005	1
3	ATTEN, 7535-01	7535-01	W-I	1113-20-0026	1
8	SWP DRIVE, M2E-1	M2E-1	W-I	1114-00-0087	1
9	CW SOURCE, M3E-1	M3E-1	W-I	1114-00-0088	1
10	CW SOURCE, M3E-2	M3E-2	W-I	1114-00-0098	1
42	PULSE MKR, M4E-2	M4E-2	W-I	1114-00-0216	1
12	SWP OSC, M9L	M9L	W-I	1114-00-0060	1
13	OUTPUT AMP, M10GA	M10GA	W-I	1114-00-0032	1
4	36 CH CATV PROGRAM SW ASSY, IF-13, A-W	RS07	W-I	1112-00-0018	1
7	SMC TERM, 50 A500-267	A500-267	W-I	1118-00-0007	1
5	REMOTE JUMPER PLUG A500-223	A500-233	W-I	1118-00-0001	1
6	HARNESS ASSY	WY1402A	W-I	1219-00-0049	1
A1 A6 A7	CABLE ASSY, 5 IN	WX3000-200-W18	W-I	1217-00-0050	3
TITLE		ASSEMBLY NO.			REV
SWP GEN, 1402A		1010-00-0066			C
WAVETEK PARTS LIST		PAGE: 1			

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
A2	CABLE ASSY, 5-1/2 IN	WX1402A-A2	W-I	1217-70-0003	1
A3	CABLE ASSY, 7-3/4 IN	WX1402A-A3	W-I	1217-70-0004	1
A4	CABLE ASSY, 12-1/2 IN	WX1402A-A4	W-I	1217-80-0013	1
A5	CABLE ASSY, 6-1/2 IN	WX3000-200-W4	W-I	1217-00-0064	1
A8	CABLE ASSY, 4-1/4 IN	WX1402A-A8	W-I	1217-00-0042	1
A9	CABLE ASSY, 3 IN	WX1504-A3	W-I	1217-00-0030	1
TITLE		ASSEMBLY NO.			REV
SWP GEN, 1402A		1010-00-0066			C
PAGE: 2					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
10	INDICATOR LT MB000-003	99-33080-5P47TL-018	M-D	2410-02-0003	1
16	CONN, UG911A/U JB109-111	KC79-146	KIN	2110-01-1013	1
17	CONN JB000-015	21JR101-2	S-C	2110-01-2001	1
21	CHOKE, 10.0MH, 10% LA005-010	OBN100K	ASE	1810-03-0100	2
11	POT, 10K, RP134-310	RK45	CTS	4610-30-2103	2
12	POT, 10K RP118-310	JAIN056S103MA	A-B	4610-10-5103	1
22	RES. C, 1/4W, 5%, 91K RC103-391	CF1/4-91K	ASE	4700-15-9102	2
7	SW, 5-STA, 2-POLE, PP SZ000-013	PB15-304B BUTTON	CTL	5110-00-0010	1
WAVETEK PARTS LIST		TITLE CHASSIS, 1402A ASSEMBLY NO. 1111-00-0015 PAGE: 1			REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
1	RECEPTACLE, MC000-030	03-09-1121	MOL	2113-08-0001	1	
2	TERM, MALE MC000-033	02-09-2143	MOL	2113-09-0002	1	
3	TERMINAL, FEMALE MC000-032	02-09-1143	MOL	2113-09-0001	7	
4	RECEPTACLE, MC000-016	03-06-1151	MOL	2113-03-0001	2	
5	TERMINAL, FEMALE MC000-018	02-06-1131	MOL	2113-05-0001	29	
6	CONN, JB000-003	KC19-175	KIN	2110-01-1012	2	
7	RECEPTACLE MC000-043	03-06-1011	MOL	2113-03-0003	1	
WAVETEK PARTS LIST		TITLE HARNESS ASSY			ASSEMBLY NO. 1219-00-0049 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
J101	PLUG, MC000-017	03-06-2151	MDL	2113-04-0001	1
2	TERMINAL, MALE MC000-019	1854	MDL	2113-05-0002	8
WAVETEK PARTS LIST		TITLE REMOTE JUMPER PLUG A500-223		ASSEMBLY NO. 1118-00-0001 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C7	CAP, CER, .1MF, 50V CD103-410	TGP-10	SPR	1510-10-2104	1
F1	FUSE, S.B., .5 AMP MF000-007	MDL 1/2	BUS	2410-05-0004	1
J1	RECEPTACLE MC000-034	03-06-1041	MDL	2113-03-0002	1
12	TERMINAL, FEMALE MC000-018	02-06-1131	MDL	2113-05-0001	4
J5	CONN, UG911A/U JB109-111	KC79-146	KIN	2110-01-1013	1
P3	CORD SET, 18/3SVT, 6FT GRY, MLD, CAP, UL-APPRV	17237SVT	BEL	6011-80-0001	1
Q2 Q3	TRANS GA052-940	2N5294	RCA	4901-05-2940	2
R44	POT, 20K RP124-320	WA2G032S-203MA	A-B	4610-10-7203	1
S1	SWITCH, SLIDE, DPDT	EPSI-SLI	S-I	5105-00-0011	1
S2	SWITCH, TOGGLE ST000-003	MTA106D	ALC	5106-00-0002	1
T1	XFMR, PWR, TT000-022	TT000-022	W-I	5610-00-0006	1
14	POWER SUPPLY BOARD	PS7 CARD	W-I	1218-00-0013	1
WAVETEK PARTS LIST		TITLE POWER SUPPLY, PS7		ASSEMBLY NO. 1115-00-0005 PAGE: 1	REV G

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C07	CAP, ELECT, 1250MF, 50V CE114-212	1510-20-7122	MAL	1510-20-7122	2
C02	CAP, ELECT, 50MF, 50V CE107-050	TE1307	SPR	1510-20-5500	1
C03 C06 C11	CAP, ELECT, 100MF, 25V CE105-110	TE1211	SPR	1510-20-4101	3
C04 C09	CAP, CER, 100PF, 1KV CD102-110	60U101M	MDC	1510-10-1101	2
C05	CAP, CER, .005MF, 100V	TG-D50	SPR	1510-10-2502	1
C08	CAP, CER, 120PF, 1KV CD102-112	60U121M	MDC	1510-10-1121	1
C10 C12 C14	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	3
C13	CAP, MYLAR, .15MF, 100V CP103-415	WMF1P15	C-D	1510-60-2154	1
C16	CAP, CER, .05MF, 100V CD103-350	TG-S50	SPR	1510-10-2503	1
CR01 CR02 CR03 CR04 CR05 CR06 CR07 CR08 CR09 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR17	DIODE DR000-001	1N4004	P-C	4806-01-4004	17
IC1	IC, IC000-001	LM723CH	NAT	7000-17-2300	1
WAVETEK PARTS LIST		TITLE POWER SUPPLY BOARD		ASSEMBLY NO. 1218-00-0013 PAGE: 1	
				REV E	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
IC2	IC, IC000-002	N5741CV	SIG	7000-57-4100	1
IC3	IC, IC000-005	RC4558DN	RAY	7000-14-5800	1
P2	WAFERCON, MC000-031	1840-12-2	MOL	2112-09-0001	1
Q01 Q04 Q05	TRANS GA036-440	2N3644	FCD	4901-03-6440	3
Q06 Q13	TRANS GA038-541	2N3854A	G-E	4901-03-8541	2
Q07	TRANS GA053-060	2N5306	G-E	4901-05-3060	1
Q12	TRANS QB000-009	MPS3702	MDT	4902-03-7020	1
R01	RES, C, 1/4W, 5%, 270 RC103-127	CF1/4-270	ASE	4700-15-2700	1
R02	RES, C, 1/4W, 5%, 1.8K RC103-218	CF1/4-1.8K	ASE	4700-15-1801	1
R03 R11 R21 R46	RES, 1/2W, 1%, 5 RD01R-050	K20-5	KID	4701-23-0050	4
R04 R14	RES, MF, 1/8W, 1%, 1K RF212-100	MF55K-1K	ASE	4701-03-1001	2
R05	RES, MF, 1/8W, 1%, 12.1K RF213-121	MF55K-12.1K	ASE	4701-03-1212	1
R06	RES, C, 1/4W, 5%, 1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	1
R07	RES, C, 1/4W, 5%, 220 RC103-122	CF1/4-220	ASE	4700-15-2200	1
WAVETEK PARTS LIST		TITLE POWER SUPPLY BOARD		ASSEMBLY NO. 1218-00-0013 PAGE: 2	
				REV E	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R08	RES, C, 1/4W, 5%, 3.9K RC103-239	CF1/43.9K	ASE	4700-15-3901	1
R09	POT, 1K, RP131-210	360T102B	CTS	4610-00-3102	1
R10	RES, C, 1/4W, 5%, 2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	1
R12	RES, C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	1
R13	RES, C, 1/2W, 5%, 2.7K RC105-227	CF1/2-2.7K	ASE	4700-25-2701	1
R15	RES, MF, 1/8W, 1%, 15K RF213-150	MF55K-15K	ASE	4701-03-1502	1
R16 R17	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	2
R18	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	1
R19 R20	RES, SET, 2-10K, 1/8W QTY: 2: 4701-03-1002	RX000-003	W-I	4789-00-0004	1
R22 R29 R30 R38 R42	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	5
R23 R28 R39 R41	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	4
WAVETEK PARTS LIST	TITLE POWER SUPPLY BOARD		ASSEMBLY NO. 1218-00-0013		REV E
			PAGE: 3		

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R24	RES, C, 1/4W, 5%, 100 RC103-110	CF1/4-100	ASE	4700-15-1000	1
R25	RES, C, 1/4W, 5%, 15K RC103-315	CF1/4-15K	ASE	4700-15-1502	1
R26 R44	POT, 20K, RP131-320	360T203B	CTS	4610-00-3203	2
R27	RES, C, 1/4W, 5%, 220K RC103-422	CF1/4220K	ASE	4700-15-2203	1
R31	RES, C, 1/4W, 5%, 47 RC103-047	CF1/4-47	ASE	4700-15-4709	1
R40	RES, C, 1/4W, 5%, 22K RC103-322	CF1/422K	ASE	4700-15-2202	1
R43	RES, C, 1/4W, 5%, 18K RC103-318	CF1/4-18K	ASE	4700-15-1802	1
R45	RES, C, 1/2W, 5%, 220 RC105-122	CF1/2-220	ASE	4700-25-2200	1
WAVETEK PARTS LIST	TITLE POWER SUPPLY BOARD		ASSEMBLY NO. 1218-00-0013		REV E
			PAGE: 4		

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
CRO1 CRO2 CRO3 CRO4 CRO5 CRO6 CRO7 CRO8 CRO9 CR10 CR11 CR12	DIODE DG109-140	1N4148	FCD	4807-01-0914	12
IC01	IC, IC000-005	RC4558DN	RAY	7000-14-5800	1
IC02	IC, IC000-002	N5741CV	SIG	7000-57-4100	1
IC03	IC, IC000-028	93L01PC	FCD	7000-93-0110	1
IC04	POS VOLT REG	MA78L05AWC	FCD	7000-78-0501	1
Q01 Q02 Q03 Q04 Q05 Q06 Q07 Q08 Q09 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17 Q18 Q19 Q20 Q21 Q23 Q24 Q37 Q38 Q40	TRANS GA054-580	2N5458	MOT	4901-05-4580	26
Q22	TRANS GA054-610	2N5461	MOT	4901-05-4610	1
Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32 Q33 Q34 Q35 Q39	TRANS GB000-009	MPS3702	MOT	4902-03-7020	12
Q36	TRANS GA038-541	2N3854A	Q-E	4901-03-8541	1
Q41 Q42 Q43 Q44 Q45 Q46 Q47 Q48	TRANS GA039-040	2N3904	T-I	4901-03-9040	8
R01 R34 R41 R50	RES, MF, 1/8W, 1%, 12.1K RF213-121	MF55K-12.1K	ASE	4701-03-1212	4
TITLE		ASSEMBLY NO.			REV
36 CH CATV PROGRAM SW ASSY, IF-13, A-W		1112-00-0018			D
		PAGE: 1			
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
R02	RES, MF, 1/8W, 1%, 3.92K RF212-392	MF55K-3.92K	ASE	4701-03-3921	1	
R03 R04 R05 R06 R07 R08 R09	RES, MF, 1/8W, 1%, 10K RF213-100	MF55K10K	ASE	4701-03-1002	7	
R10 R47	RES, MF, 1/8W, 1%, 15K RF213-150	MF55K-15K	ASE	4701-03-1502	2	
R11	RES, MF, 1/8W, 1%, 4.02K RF212-402	MF55K-4.02K	ASE	4701-03-4021	1	
R12 R13 R14 R15 R16 R17 R18	POT, 100K, RP129-410	360S104B	CTS	4610-00-1104	7	
R19 R20 R21 R22 R23 R24 R25 R26 R27 R28 R29 R30 R37 R38 R43 R44 R53 R54 R55 R56 R57 R58 R67 R69 R82 R83 R86	RES, C, 1/4W, 5%, 10M RC103-610	CB1065	A-B	4700-15-1005	27	
R31	RES, MF, 1/8W, 1%, 3.48K RF212-348	MF55K-3.48K	ASE	4701-03-3481	1	
R32 R33	RES, MF, 1/8W, 1%, 1.50K RF212-150	MF55K-1.50K	ASE	4701-03-1501	2	
R35 R36 R42	POT, 10K, RP129-310	360S103B	CTS	4610-00-1103	3	
R39	RES, MF, 1/8W, 1%, 5.11K RF212-511	MF55K-5.11K	ASE	4701-03-5111	1	
WAVETEK PARTS LIST		TITLE 36 CH CATV PROGRAM SW ASSY, IF-13, A-W			ASSEMBLY NO. 1112-00-0018 PAGE: 2	REV D

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R40	RES, MF, 1/8W, 1%, 2.74K RF212-274	MF55K-2.74K	ASE	4701-03-2741	1
R45 R46 R64 R94	RES, C, 1/4W, 5%, 100 RC103-110	CF1/4-100	ASE	4700-15-1000	4
R48 R49 R51 R52	RES, MF, 1/8W, 1%, 6.81K RF212-681	MF55K-6.81K	ASE	4701-03-6811	4
R59 R60 R61 R62 R63	RES, C, 1/4W, 5%, 1M RC103-510	CF1/4-1M	ASE	4700-15-1004	5
R66 R70 R71 R72 R73 R74 R75 R76 R77 R78 R79 R85	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	12
R87 R88 R89	RES, C, 1/4W, 5%, 15K RC103-315	CF1/4-15K	ASE	4700-15-1502	3
R90 R91 R92 R93	RES, C, 1/4W, 5%, 1.8K RC103-218	CF1/4-1.8K	ASE	4700-15-1801	4
R100 R101 R102 R95 R96 R97 R98 R99	RES, C, 1/4W, 5%, 27K RC103-327	CF1/4-27K	ASE	4700-15-2702	8
R103 R104 R105 R106 R107 R108 R109 R110 R65 R68 R80 R81 R84	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	13
S1	ROTARY SWITCH SR000-034	SR000-034	W-I	5104-00-0230	1
Z1	HARNESS ASSY	WYRS07	W-I	1219-10-0001	1
WAVETEK PARTS LIST		TITLE 36 CH CATV PROGRAM SW ASSY, IF-13, A-W ASSEMBLY NO. 1112-00-0018 PAGE: 3			REV D

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
P102	PLUG, MC000-017	03-06-2151	MDL	2113-04-0001	1
P103	PLUG MC000-044	03-06-2011	MDL	2113-04-0003	1
1	TERMINAL, MALE MC000-019	1854	MDL	2113-05-0002	16
WAVETEK PARTS LIST		TITLE HARNESS ASSY			ASSEMBLY NO. 1219-10-0001 PAGE: 1
					REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
C1 C10 C2 C5 C6 C9	CAP, F. T., 6.8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	6	
C3 C4	CAP, Q. C., 3.9PF CG101-239	QC-3.9PF	Q-C	1510-40-0399	2	
C7 C8	CAP, Q-C, 2.4PF, 10% CG101-224	QC-2.4PF	Q-C	1510-40-0249	2	
C13 C14	CAP, F. T., 470PF CF101-147	FA5C-4712	A-B	1510-30-0471	2	
CR1 CR2 CR3 CR4 CR5	DIODE DR000-001	1N4004	P-C	4806-01-4004	5	
IC1	IC, IC000-005	RC4558DN	RAY	7000-14-5800	1	
Q1	TRANS-GA042-500	2N4250	FCD	4901-04-2500	1	
R1 R2 R42	RES, SET, 3-178K, 1/8W QTY: 3: 4701-03-1783	RX000-002	W-I	4789-00-0001	1	
R3 R4	RES, MF, 1/8W, 1%, 10K RF213-100	MF55K10K	ASE	4701-03-1002	2	
R15 R31 R5 R8	POT, 20K, RP130-320	B9PR20K	BEK	4610-00-2203	4	
R6	RES, C, 1/4W, 5%, 470K RC103-447	CF1/4-470K	ASE	4700-15-4703	1	
R7	RES, C, 1/4W, 5%, 150K RC103-415	CF1/4-150K	ASE	4700-15-1503	1	
R9	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	1	
WAVETEK PARTS LIST		TITLE SWP DRIVE, M2E-1			ASSEMBLY NO. 1114-00-0087 PAGE: 1	REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
R10	RES, C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	1	
R11 R12 R13 R14	RES, C, 1/4W, 5%, 2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	4	
R16 R17 R18 R32	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	4	
R19 R27	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	2	
R20 R22 R24 R26 R28	POT, 100K, RP130-410	B9PR100K	BEK	4610-00-2104	5	
R21 R23 R25	RES, C, 1/4W, 5%, 220K RC103-422	CF1/4220K	ASE	4700-15-2203	3	
R29	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1	
R30	RES, C, 1/4W, 5%, 18K RC103-318	CF1/4-18K	ASE	4700-15-1802	1	
R41	RES, C, 1/4W, 5%, 51K RC103-351	CF1/4-51K	ASE	4700-15-5102	1	
WAVETEK PARTS LIST		TITLE SWP DRIVE, M2E-1			ASSEMBLY NO. 1114-00-0087 PAGE: 2	REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C1A C1B C1C C1D C1E	CAP, CER, 20PF, 1KV CD101-020	60C0G200J	MDC	1510-10-0200	5
C1F C2A C2B C2C C2D C2E	CAP, CER, 120PF, 1KV CD104-112	10TCU-T12	SPR	1510-10-3121	6
C3A C3B C3C C3D C3E	CAP, CER, 47PF, 1KV CD104-047	60U2J470J	MDC	1510-10-3470	5
C16 C17 C4A C4B C4C C4D C4E C9A C9B C9C C9D C9E	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	12
C20 C22 C23 C5A C5B C5C C5D C5E C6A C6B C6C C6D C6E	CAP, CER, F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	13
C7A C7B C7C C7D C7E	CAP, G.C., 3PF CG101-230	QC-3PF	Q-C	1510-40-0030	5
C8A C8B C8C C8D C8E	CAP, CER, 15PF, 1KV CD101-015	10TCC-Q15	SPR	1510-10-0150	5
C10A C10B C10C C10D C10E C11A C11B C11C C11D C11E C12A C12B C12C C12D C12E C13	CAP, CER, 4.7PF, 1KV CD101-R47	10TCC-V47	SPR	1510-10-0479	16
C14	CAP, CER, .05MF, 100V CD103-350	TG-S50	SPR	1510-10-2503	1
C15	CAP, CER, .005MF, 100V	TG-D50	SPR	1510-10-2502	1
TITLE CW SOURCE, M3E-1		ASSEMBLY NO. 1114-00-0088 PAGE: 1			REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
C18	CAP, CER, 470PF, 1KV CD102-147	60U471M	MDC	1510-10-1471	1	
C21	CAP, F.T., 6.8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	1	
CR1A CR1B CR1C CR1D CR1E	DIODE D9000-001	1N4004	P-C	4806-01-4004	5	
CR2A CR2B CR2C CR2D CR2E CR3	DIODE DP000-040	MA47980	M-A	4805-02-0001	6	
CR4	DIODE D9100-821	1N82AG	G-I	4807-01-0082	1	
J1 J2 J3 J4	CONN JF000-005	37JR116-1	S-C	2110-03-0002	4	
L1A L1B L1C L1D L1E L1A L43 L4C L4D L4E L5A L5B L5C L5D L5E L6A L6B L6C L6D L6E	RF CHOKE	CHOKE	W-I	1819-99-9999	20	
L2A L2B L2C L2D L2E	CHOKE, 2.2MH, 10% LA005-R22	08N2R2K	ASE	1810-03-0229	5	
L03A L03B L03C L03D L03E	TORRID, 10 TURN	LA009-010-1	HYT	1810-05-0004	5	
-	CHOKE, 1.2MH, 10% LA005-R02	08NR22K	ASE	1810-03-0228	1	
-	TEMP, CO, CHOKE LA009-010	T1255-1	HYT	1810-05-0002	1	
WAVETEK PARTS LIST		TITLE CW SOURCE, M3E-1			ASSEMBLY NO. 1114-00-0088 PAGE: 2	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
Q1A Q1B Q1C Q1D Q1E	TRANS GA03B-541	2N3854A	G-E	4901-03-8541	5	
Q2A Q2B Q2C Q2D Q2E	TRANS GA051-790	2N5179	RCA	4901-05-1790	5	
Q3	TRANS GA054-580	2N5458	MDT	4901-05-4580	1	
Q4	TRANS QB000-010	TD101	SPR	4902-00-1010	1	
Q5	TRANS QB000-009	MPS3702	MDT	4902-03-7020	1	
R1A R1B R1C R1D R1E R25 R26	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	7	
R2A R2B R2C R2D R2E	RES, C, 1/4W, 5%, 56 RC103-056	CF1/4-56	ASE	4700-15-5609	5	
R3A R3B R3C R3D R3E	RES, C, 1/4W, 5%, 1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	5	
R23 R24 R4A R4B R4C R4D R4E R8A R8B R8C R8D R8E	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	12	
R10 R5A R5B R5C R5D R5E	RES, C, 1/4W, 5%, 2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	6	
R6A R6B R6C R6D R6E	RES, C, 1/4W, 5%, 3.9K RC103-239	CF1/4-3.9K	ASE	4700-15-3901	5	
R16 R7A R7B R7C R7D R7E	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	6	
R20 R9	RES, C, 1/4W, 5%, 2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	2	
WAVETEK PARTS LIST		TITLE CW SOURCE, M3E-1			ASSEMBLY NO. 1114-00-0088 PAGE: 3	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R11 R12 R14	RES, C, 1/4W, 5%, 47 RC103-047	CF1/4-47	ASE	4700-15-4709	3
R13	RES, C, 1/4W, 5%, 100 RC103-110	CF1/4-100	ASE	4700-15-1000	1
R15	RES, C, 1/4W, 5%, 1M RC103-510	CF1/4-1M	ASE	4700-15-1004	1
R17	RES, C, 1/4W, 5%, 2.2M RC103-522	CF1/4-2.2M	ASE	4700-15-2204	1
R18	RES, C, 1/4W, 5%, 470K RC103-447	CF1/4-470K	ASE	4700-15-4703	1
R19	RES, 20K RP124-320	WA26032S-203MA	A-B	4610-10-7203	1
R21	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	1
R22	RES, C, 1/4W, 5%, 220 RC103-122	CF1/4-220	ASE	4700-15-2200	1
XA XB XC XD XE	CRYSTAL, XX000-331	X33W-00.00000	W-I	2310-00-0331	5
TITLE CW SOURCE, M3E-1		ASSEMBLY NO. 1114-00-0088 PAGE: 4		REV B	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
C01A C01B C01C C01D C01E C01F C10A C10B C10C C10D C10E C10F	CAP, CER, 20PF, 1KV CD101-020	60C0G200J	MDC	1510-10-0200	12	
C2A C2B C2C C2D C2E C2F	CAP, CER, 120PF, 1KV CD104-112	10TCU-T12	SPR	1510-10-3121	6	
C3A C3B C3C C3D C3E C3F	CAP, CER, 47PF, 1KV CD104-047	60U2J470J	MDC	1510-10-3470	6	
C11A C11B C11C C11D C11E C4A C4B C4C C4D C4E C4F C9A C9B C9C C9D C9E	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	16	
C5A C5B C5C C5D C5E C6A C6B C6C C6D C6E C6F C99	CAP, CER, F. T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	12	
C7I	CAP, CER, 6.8PF, 1KV CD101-R68	60CDH6R8D	MDC	1510-10-0689	1	
C7B C7C C7D C7E C7F	CAP, CER, 10PF, 1KV CD101-010	10TCC-Q10	SPR	1510-10-0100	5	
C10BB	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	1	
C12A C12B C12C C12D C12E	CAP, G. C., 3PF CG101-230	QC-3PF	Q-C	1510-40-0030	5	
CR1A CR1B CR1C CR1D CR1E CR1F	DIODE DR000-001	1N4004	P-C	4806-01-4004	6	
WAVETEK PARTS LIST		TITLE CW SOURCE, M3E-2			ASSEMBLY NO. 1114-00-009B PAGE: 1	REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
J1	CONN JF000-005	37JR116-1	S-C	2110-03-0002	1
L1A L1B L1C L1D L1E L1F L4A L4B L4C L4D L4E	RF CHOKE	CHOKE	W-I	1819-99-9999	11
L2A L2B L2C L2D L2E L2F	CHOKE, 2.2MH, 10% LA005-R22	08N2R2K	ASE	1810-03-0229	6
L03A L03B L03C L03D L03E L03F	TORRID, 10 TURN	LA009-010-1	HYT	1810-05-0004	6
Q1A Q1B Q1C Q1D Q1E Q1F Q2A Q2B Q2C Q2D Q2E	TRANS QA038-541	2N3854A	G-E	4901-03-8541	11
R1A R1B R1C R1D R1E R1F	RES, C, 1/4W, 5%, 56 RC103-056	CF1/4-56	ASE	4700-15-5609	6
R2A R2B R2C R2D R2E R2F R6A R6B R6C R6D R6E	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	11
R3A R3B R3C R3D R3E R3F R7D RE	RES, C, 1/4W, 5%, 1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	8
R4A R4B R4C R4D R4E	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	5
X1A X1B X1C X1D X1E X1F	CRYSTAL, XX000-331	X33W-00.00000	W-I	2310-00-0331	6
TITLE CW SOURCE, M3E-2		ASSEMBLY NO. 1114-00-009B PAGE: 2		REV C	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C11 C36 C37	CAP, CER, 470PF, 1KV CD102-147	60U471M	MDC	1510-10-1471	4
C02 C04 C10 C20	CAP, CER, 15PF, 1KV CD101-015	10TCC-G15	SPR	1510-10-0150	4
C03 C12 C14 C43	CAP, CER, .025MF, 50V CD103-325	TG-S25	SPR	1510-10-2253	4
C05 C07 C08	CAP, VARI, 7.35PF, 250V CV101-035	7STRIKO-02	STR	1510-70-0350	3
C06	CAP, Q-C, 2.4PF, 10% CG101-224	QC-2.4PF	G-C	1510-40-0249	1
C09 C34 C35 C39	CAP, CER, .005MF, 100V	TG-D50	SPR	1510-10-2502	4
C013 C15 C24	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	3
C16 C30	CAP, MICA, 180PF, 500V CM101-118	DM15-181J	ARC	1510-50-0181	2
C17	CAP, CER, 4.7PF, 1KV CD101-R47	10TCC-V47	SPR	1510-10-0479	1
C18	CAP, CER, 10PF, 1KV CD101-010	10TCC-G10	SPR	1510-10-0100	1
C19	CAP, Q-C, 2.0PF, 10% CG101-220	QC-2.0PF	G-C	1510-40-0020	1
C21	CAP, CER, 25PF, 1KV CD101-025	60C0G250J	MDC	1510-10-0250	1
TITLE PULSE MKR, M4E-2		ASSEMBLY NO. 1114-00-0216 PAGE: 1			REV E
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
C22	CAP, CER, 120PF, 1KV CD104-112	10TCU-T12	SPR	1510-10-3121	1	
C25	CAP, CER, 47PF, 1KV CD104-047	60U2J470J	MDC	1510-10-3470	1	
C27 C49 C51	CAP, F. T. , 470PF CF101-147	FA5C-4712	A-B	1510-30-0471	3	
C28 C46 C47 C48	CAP, F. T. , 6.8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	4	
C29 C31 C32	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	3	
C33	CAP, CER, 200PF, 1KV CD102-120	56A-T20	SPR	1510-10-1201	1	
C38	CAP, CER, 20PF, 1KV CD101-020	60C0G200J	MDC	1510-10-0200	1	
C40	CAP, TANT, .47MF, 50V CE113-447	935	TRW	1510-21-9470	1	
C41	CAP, CER, 270PF, 1KV CD102-127	60U271M	MDC	1510-10-1271	1	
C42	CAP, CER, .002MF, 1KV CD102-220	56AD20	SPR	1510-10-1202	1	
C44 C45	CAP, CER, .05MF, 100V CD103-350	TG-S50	SPR	1510-10-2503	2	
WAVETEK PARTS LIST		TITLE PULSE MKR, M4E-2			ASSEMBLY NO. 1114-00-0216 PAGE: 2	REV E

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C50	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	1
CR01	DIODE DG100-821	1N82AG	Q-I	4807-01-0082	1
CR04	DIODE DG100-341	1N34A	HIT	4807-01-0034	1
CR05	DIODE DR000-001	1N4004	P-C	4806-01-4004	1
IC01	IC, IC000-002	N5741CV	SIG	7000-57-4100	1
J01 J02 J03	CONN JF000-005	37JR116-1	S-C	2110-03-0002	3
L01 L02 L03 L04 L06 L08 L12	RF CHOKE	CHOKE	W-I	1819-99-9999	7
L05	TORRID, 10 TURN	LA009-010-1	HYT	1810-05-0004	1
L07 L11	FERRITE CHOKE, 4 TURN FROM: 1813-00-0007	LA007-004	W-I	1210-30-0005	2
Q01	DUAL-INS-GATE-FFET	3N211	RCA	4903-00-2110	1
Q02 Q03	TRANS QA051-790	2N5179	RCA	4901-05-1790	2
Q04 Q06 Q07 Q08 Q09 Q10 Q11 Q12	TRANS QA03B-541	2N3854A	Q-E	4901-03-8541	8
Q05	TRANS QB000-020	40B41	RCA	4902-40-8410	1
R01 R15 R20	RES, C, 1/4W, 5%, 56 RC103-056	CF1/4-56	ASE	4700-15-5609	3
WAVETEK PARTS LIST		TITLE PULSE MKR, M4E-2		ASSEMBLY NO. 1114-00-0216 PAGE: 3	REV E

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R02*	RES, C, 1/4W, 5%, 470K RC103-447	CF1/4-470K	ASE	4700-15-4703	1
R03 R25 R30 R36 R44 R45	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	6
R04	RES, C, 1/4W, 5%, 75 RC103-075	CR1/4-75	ASE	4700-15-7509	1
R05	RES, C, 1/4W, 5%, 120 RC103-112	CF1/4-120	ASE	4700-15-1200	1
R06	RES, C, 1/4W, 5%, 5.6K RC103-256	CF1/4-5.6K	ASE	4700-15-5601	1
R07 R31 R49	RES, C, 1/4W, 5%, 2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	3
R08	RES, C, 1/4W, 5%, 680 RC103-168	CF1/4-680	ASE	4700-15-6800	1
R09	RES, C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	1
R10	RES, C, 1/4W, 5%, 3.3K RC103-233	CF1/4-3.3K	ASE	4700-15-3301	1
R11	RES, C, 1/4W, 5%, 10 RC103-010	CF1/4-10	ASE	4700-15-1009	1
R12 R13 R24 R29 R35 R39 R47	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	7
WAVETEK PARTS LIST		TITLE PULSE MKR, M4E-2		ASSEMBLY NO. 1114-00-0216 PAGE: 4	REV E

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R14	RES, C, 1/4W, 5%, 100 RC103-110	CF1/4-100	ASE	4700-15-1000	1
R16 R32 R41	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	3
R17	RES, C, 1/4W, 5%, 1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	1
R19 R27 R28 R34 R42	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	5
R23	RES, C, 1/4W, 10%, 10M RC104-610	CB1061	A-B	4700-16-1005	1
R26	RES, C, 1/4W, 5%, 220 RC103-122	CF1/4-220	ASE	4700-15-2200	1
R33	RES, C, 1/4W, 5%, 12K RC103-312	CF1/4-12K	ASE	4700-15-1202	1
R37	RES, C, 1/4W, 5%, 270K RC103-427	CF1/4-270K	ASE	4700-15-2703	1
R38	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	1
R40	RES, C, 1/4W, 5%, 220K RC103-422	CF1/4220K	ASE	4700-15-2203	1
R43 R46 R48	RES, C, 1/4W, 5%, 22K RC103-322	CF1/422K	ASE	4700-15-2202	3
TITLE PULSE MKR, M4E-2		ASSEMBLY NO. 1114-00-0216 PAGE: 5			REV E
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
23	RES, C, 1/4W, 5%, 2.2M RC103-522	CF1/4-2.2M	ASE	4700-15-2204	2
T01	RF XFMR FROM: 1813-00-0001	1210-42-0015	W-I	1210-42-0015	1
X01	CRYSTAL, XX000-331	X33W-00.00000	W-I	2310-00-0331	1
TITLE PULSE MKR, M4E-2		ASSEMBLY NO. 1114-00-0216 PAGE: 6			REV E

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
C1 C21	CAP, F. T., 6.8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	2	
C2	CAP, CER, 4.7PF, 1KV CD101-R47	10TCC-V47	SPR	1510-10-0479	1	
C3 C8	CAP, MICA, 180PF, 500V CM101-118	DM15-181J	ARC	1510-50-0181	2	
C4 C6 C7	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	3	
C17 C5	CAP, TANT, .47MF, 50V CE113-447	935	TRW	1510-21-9470	2	
C9	CAP, CER, 200PF, 1KV CD102-120	5GA-T20	SPR	1510-10-1201	1	
C10	CAP, CER, .025MF, 50V CD103-325	TQ-S25	SPR	1510-10-2253	1	
C11 C16 C19	CAP, CER, .005MF, 100V	TQ-D50	SPR	1510-10-2502	3	
C12 C13	CAP, CER, 470PF, 1KV CD102-147	60U471M	MDC	1510-10-1471	2	
C14	CAP, CER, .001MFD, 1KV CD102-210	5GAD10	SPR	1510-10-1102	1	
C15	CAP, CER, 20PF, 1KV CD101-020	60C0G200J	MDC	1510-10-0200	1	
C18	CAP, CER, 270PF, 1KV CD102-127	60U271M	MDC	1510-10-1271	1	
WAVETEK PARTS LIST		TITLE PULSE MKR, M6P			ASSEMBLY NO. 1114-00-0129 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
C20	CAP, CER, .05MF, 100V CD103-350	TG-S50	SPR	1510-10-2503	1	
C22	CAP, F. T., 470PF CF101-147	FA5C-4712	A-B	1510-30-0471	1	
CR1	DIODE DG100-341	1N34A	HIT	4807-01-0034	1	
CR2	DIODE DR000-002	ED30015	ETP	4806-01-4006	1	
IC1	IC, IC000-002	N5741CV	SIG	7000-57-4100	1	
L1 L2	RF CHOKE	CHOKE	W-I	1819-99-9999	2	
Q1	TRANS QB000-016 STATIC SENSITIVE	40673	RCA	4902-40-6730	1	
Q2 Q3 Q4 Q5 Q6 Q7	TRANS QA03B-541	2N3854A	G-E	4901-03-8541	6	
R1	RES, C, 1/4W, 10%, 10M RC104-610	CB1061	A-B	4700-16-1005	1	
R2	RES, C, 1/4W, 5%, 220K RC103-422	CF1/4220K	ASE	4700-15-2203	1	
R3	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	1	
R10 R23 R4	RES, C, 1/4W, 5%, 2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	3	
R5	RES, C, 1/4W, 5%, 220 RC103-122	CF1/4-220	ASE	4700-15-2200	1	
WAVETEK PARTS LIST		TITLE PULSE MKR, M6P			ASSEMBLY NO. 1114-00-0129 PAGE: 2	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R13 R18 R6 R7	RES. C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	4
R11 R15 R20 R21 R8	RES. C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	5
R14 R9	RES. C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	2
R12	RES. C, 1/4W, 5%, 12K RC103-312	CF1/4-12K	ASE	4700-15-1202	1
R16	RES. C, 1/4W, 5%, 270K RC103-427	CF1/4-270K	ASE	4700-15-2703	1
R17	RES. C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	1
R19 R22	RES. C, 1/4W, 5%, 22K RC103-322	CF1/422K	ASE	4700-15-2202	2
WAVETEK PARTS LIST		TITLE PULSE MKR, M6P			ASSEMBLY NO. 1114-00-0129 PAGE: 3
					REV

REFERENCE DESIGNATORS	PART DESCRIPTION	GRIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C02	CAP, CER, 33PF, 1KV CD101-033	10TCC-Q33	SPR	1510-10-0330	2
C03	CAP, CER, 100PF, 1KV CD102-110	60U101M	MDC	1510-10-1101	1
C04 C15	CAP, CER, 10PF, 1KV CD101-010	10TCC-Q10	SPR	1510-10-0100	2
C05 C21 C37A C37B C37C C38A C38B C38C C42 C55*	CAP, CER, .05MF, 100V CD103-350	TG-S50	SPR	1510-10-2503	10
C06 C07 C16 C17 C22 C44	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	6
C08 C09 C23 C28 C50	CAP, CER, .025MF, 50V CD103-325	TG-S25	SPR	1510-10-2253	5
C10 C20 C27 C29 C46	CAP, CER, .001MFD, 1KV CD102-210	56AD10	SPR	1510-10-1102	5
C11 C24 C25	CAP, CER, 47PF, 1KV CD104-047	60U2J470J	MDC	1510-10-3470	3
C12 C19	CAP, CER, 20PF, 1KV CD101-020	60C0G200J	MDC	1510-10-0200	2
C13 C40 C41	CAP, CER, 120PF, 1KV CD104-112	10TCU-T12	SPR	1510-10-3121	3
C14	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	1
WAVETEK PARTS LIST		TITLE IF MKR, M7E		ASSEMBLY NO. 1114-00-0197 PAGE: 1	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C18	CAP, CER, 68PF, 1KV CD104-068	68U2J680J	MDC	1510-10-3680	1
C26	CAP, CER, 25PF, 1KV CD101-025	60C0G250J	MDC	1510-10-0250	1
C30 C32 C34	CAP, VAR, 3.5-13PF250V CV101-013	7S-TRIKO-02-3.5-13PF	STR	1510-70-0130	3
C36A C36B C36C C39A C39B C39C	CAP, CER, 200PF, 1KV CD102-120	56A-T20	SPR	1510-10-1201	6
C43 C47 C55	CAP, F. T., 6.8PF CF102-R68	54-794-010-6892	SPEC	1510-30-1689	3
C45	CAP, CER, .02UF, 50V	TG-S20	SPR	1510-10-2203	1
C48* C49	CAP, TANT, .47MF, 50V CE113-447	935	TRW	1510-21-9470	2
C51 C53	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	2
C52 C54	CAP, F. T., 470PF CF101-147	FA5C-4712	A-B	1510-30-0471	2
CR01 CR06	DIODE DRO00-001	1N4004	P-C	4806-01-4004	2
CR02 CR03A CR03B CR03C CR04A CR04B CR04C CR05	DIODE DG100-341	1N34A	HIT	4807-01-0034	8
IC01	IC, IC000-002	N5741CV	SIG	7000-57-4100	1
WAVETEK PARTS LIST		TITLE IF MKR, M7E		ASSEMBLY NO. 1114-00-0197 PAGE: 2	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
J01	CONN JF000-005	37JR116-1	S-I	2110-03-0002	1
L01 L02 L03	CH0KE .22MH 10% LA005-R02	08NR22K	ASE	1810-03-0222	1
L04 L05 L07 L09	RF CH0KE	CH0KE	W-I	1819-99-9999	4
L06	TORRID, 4 TURN	LA009-004-1	HYT	1810-05-0003	1
L08	CH0KE, 2.2MH, 10% LA005-R22	08NR22K	ASE	1810-03-0229	1
Q01 Q03 Q04	TRANS QB000-020 STATIC SENSITIVE	40B41	RCA	4902-40-8410	3
Q02 Q07A Q07B Q07C Q08A Q08B Q08C Q09A Q09B Q09C Q11 Q12	TRANS QA038-541	2N3854A	SPR	4901-03-8541	12
Q05 Q06	TRANS QA051-790	2N5179	RCA	4901-05-1790	1
Q10 Q13	TRANS QB000-009	MPS3702	NAT	4902-03-7020	1
R01 R02	RES, C, 1/4W, 5%, 56 RC103-056	CF1/4-56	ASE	4700-15-5609	2
R03	POT, 1K	WA2G032S-102MA	A-B	4610-10-7102	1
R04 R11 R16	RES, C, 1/4W, 10%, 22K RC104-622	CB2261	A-B	4700-16-2205	1
R05 R13 R17	RES, C, 1/4W, 5%, 220 RC103-122	CF1/4-220	ASE	4700-15-2200	1
WAVETEK PARTS LIST		TITLE IF MKR, M7E		ASSEMBLY NO. 1114-00-0197 PAGE 3	REV E

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R06 R23	RES, C, 1/4W, 5%, 47 RC103-047	CF1/4-47	ASE	4700-15-4709	1
R07 R14 R19	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	1
R08 R31A R31B R31C R35A R35B R35C R43 R44	RES, C, 1/4W, 5%, 27K RC103-327	CF1/4-27K	ASE	4700-15-2702	1
R09	RES, C, 1/4W, 5%, 68 RC103-068	CF1/4-68	ASE	4700-15-6809	1
R10	RES, C, 1/4W, 5%, 56K RC103-356	CF1/4-56K	ASE	4700-15-5602	1
R12 R21 R22 R40 R46	RES, C, 1/4W, 5%, 22K RC103-322	CF1/422K	ASE	4700-15-2202	5
R15 R20	RES, C, 1/4W, 5%, 10 RC103-010	CF1/4-10	ASE	4700-15-1009	1
R18 R26 R27 R28A R28B R28C R32A R32B R32C R54	RES, C, 1/4W, 5%, 2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	1
R24	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	1
R25	RES, C, 1/4W, 5%, 68K RC103-368	CF1/4-68K	ASE	4700-15-6803	1
R29A R29B R29C R34A R34B R34C R39 R42	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1005	1
WAVETEK PARTS LIST		TITLE IF MKR, M7E		ASSEMBLY NO. 1114-00-0197 PAGE 4	REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
R30A R30B R30C	RES, C, 1/4W, 5%, 1.8M RC103-518	CF1/4-1.8M	ASE	4700-15-1804	3	
R33A R33B R33C R41	RES, C, 1/4W, 5%, 1M RC103-510	CF1/4-1M	ASE	4700-15-1004	4	
R36 R37 R45	RES, C, 1/4W, 5%, 18K RC103-318	CF1/4-18K	ASE	4700-15-1802	3	
R38	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1	
R47	RES, C, 1/4W, 5%, 1.5M RC103-515	CF1/4-1.5M	ASE	4700-15-1504	1	
R48	RES, C, 1/4W, 5%, 470K RC103-447	CF1/4-470K	ASE	4700-15-4703	1	
R49 R50	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	2	
R51	POT, 20K, RP129-320	360S203B	CTS	4610-00-1203	1	
R52	RES, C, 1/4W, 5%, 3.9K RC103-239	CF1/43.9K	ASE	4700-15-3901	1	
R53	RES, C, 1/4W, 5%, 270K RC103-427	CF1/4-270K	ASE	4700-15-2703	1	
R55 R56	RES, C, 1/4W, 5%, 22 RC103-022	CF1/4-22	ASE	4700-15-2209	2	
WAVETEK PARTS LIST		TITLE IF MKR, M7E			ASSEMBLY NO. 1114-00-0197 PAGE: 5	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
T01	RF XFMR FROM: 1813-00-0002	1210-44-0001	W-I	1210-44-0001	1	
X01	CRYSTAL, XX000-331	X33W-00.00000	W-I	2310-00-0331	1	
X02 X03 X04	CRYSTAL, XX000-391	X39W-00.00000	W-I	2310-00-0391	3	
WAVETEK PARTS LIST		TITLE IF MKR, M7E			ASSEMBLY NO. 1114-00-0197 PAGE: 6	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C1 C13 C20 C21 C25 C4 C6 C7	CAP, F.T., 6.8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	8
C2	CAP, MYLAR, .1MF, 200V CP101-410	WMF2P1	C-D	1510-60-0104	1
C23 C3	CAP, MYLAR, .047MF100V CP103-347	WMF1S47	C-D	1510-60-2473	2
C05 C12	CAP, CER, 120PF, 1KV CD102-112	60U121M	MDC	1510-10-1121	2
C10 C14 C15 C16 C17 C18 C19 C29 C8 C9	CAP, CER, .001MFD, 1KV CD102-210	5GAD10	SPR	1510-10-1102	10
C11	CAP, CER, 270PF, 1KV CD102-127	60U271M	MDC	1510-10-1271	1
C22 C24	CAP, MYLAR, .15MF, 100V CP103-415	WMF1P15	C-D	1510-60-2154	2
C30	CAP, CER, .05MF, 100V CD103-350	TG-S50	SPR	1510-10-2503	1
CR3 CR4 CR5 CR6 CR7 CR9	DIODE DR000-001	1N4004	P-C	4806-01-4004	6
CR8	DIODE DB000-001	HW6.8B	MSP	4801-02-0001	1
IC1 IC2 IC3 IC4 IC7	IC, IC000-005	RC4558DN	RAY	7000-14-5800	5
IC5 IC6	IC IC000-006	MC1455P1	MOT	7000-14-5500	2
TITLE AUTO LEVEL, M8E		ASSEMBLY NO. 1114-00-0128 PAGE: 1			REV K
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
Q1 Q12 Q13 Q16 Q17 Q2 Q3 Q4	TRANS, M/PR, 2N5458 QTY: 2: 4901-05-4580	QB000-017	W-I	4998-00-0003	4
Q5 Q6	TRANS GA03B-541	2N3854A	G-E	4901-03-8541	2
Q10 Q11 Q19 Q20 Q7	TRANS GA054-580	2N5458	MOT	4901-05-4580	5
Q14 Q15 Q8 Q9	TRANS GB000-009	MPS3702	MOT	4902-03-7020	4
Q18	TRANS GA036-440	2N3644	FCD	4901-03-6440	1
R1	RES, C, 1/4W, 5%, 2.2M RC103-522	CF1/4-2.2M	ASE	4700-15-2204	1
R16 R2 R65 R77 R87	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	5
R17 R18 R19 R24 R27 R28 R3 R32 R4 R52 R58 R64 R69 R70 R79 R80	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	18
R22 R23 R5 R55 R57 R76 R85	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	2
R6	RES, C, 1/4W, 5%, 91K RC103-391	CF1/4-91K	ASE	4700-15-9102	1
R7	POT, 20K RP124-320	WA20032S-203MA	A-B	4610-10-7203	1
R12 R73 R84 R88	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	1
TITLE AUTO LEVEL, MBE		ASSEMBLY NO. 1114-00-0128 PAGE 2			REV K
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
R13	RES, C, 1/4W, 5%, 9.1K RC103-291	CF1/4-9.1K	ASE	4700-15-9101	1	
R14 R43 R47	POT, 20K, RP130-320	B9PR20K	BEK	4610-00-2203	3	
R15 R54 R78	RES, C, 1/4W, 5%, 1M RC103-510	CF1/4-1M	ASE	4700-15-1004	3	
R20 R21 R42 R46 R53 R61 R66* R68 R74 R75	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	10	
R25 R44 R45 R59 R67	RES, C, 1/4W, 5%, 470K RC103-447	CF1/4-470K	ASE	4700-15-4703	5	
R26 R37	RES, C, 1/4W, 10%, 22M RC104-622	CB2261	A-B	4700-16-2205	2	
R29	RES, C, 1/4W, 5%, 120K RC103-412	CF1/4-120K	ASE	4700-15-1203	1	
R30 R56 R82	RES, C, 1/4W, 5%, 18K RC103-318	CF1/4-18K	ASE	4700-15-1802	3	
R31 R49 R83	RES, C, 1/4W, 5%, 22K RC103-322	CF1/422K	ASE	4700-15-2202	3	
R33	RES, C, 1/4W, 5%, 33K RC103-333	CF1/4-33K	ASE	4700-15-3302	1	
R34 R50	RES, C, 1/4W, 5%, 56K RC103-356	CF1/4-56K	ASE	4700-15-5602	2	
R35	RES, C, 1/4W, 5%, 270K RC103-427	CF1/4-270K	ASE	4700-15-2703	1	
WAVETEK PARTS LIST		TITLE AUTO LEVEL, M8E			ASSEMBLY NO. 1114-00-0128 PAGE: 3	REV K

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
R36 R51	RES, C, 1/4W, 5%, 1.8K RC103-218	CF1/4-1.8K	ASE	4700-15-1801	2	
R38 R81	RES, C, 1/4W, 10%, 10M RC104-610	CB1061	A-B	4700-16-1005	2	
R39	RES, C, 1/4W, 5%, 39K RC103-339	CF1/4-39K	ASE	4700-15-3902	1	
R40 R41	RES, C, 1/4W, 5%, 180K RC103-418	CF1/4-180K	ASE	4700-15-1803	2	
R48	RES, C, 1/4W, 5%, 150K RC103-415	CF1/4-150K	ASE	4700-15-1503	1	
R60	RES, C, 1/4W, 5%, 220K RC103-422	CF1/4220K	ASE	4700-15-2203	1	
R62 R63 R86	RES, C, 1/4W, 10%, 100M RC104-710	CB1071	A-B	4700-16-1006	3	
R71	RES, C, 1/4W, 5%, 24K RC103-324	CF1/4-24K	ASE	4700-15-2402	1	
R72	RES, C, 1/4W, 5%, 2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	1	
S1 S2	SWITCH, TOGGLE ST000-003	MTA106D	ALC	5106-00-0002	2	
WAVETEK PARTS LIST		TITLE AUTO LEVEL, MBE			ASSEMBLY NO. 1114-00-0128 PAGE: 4	REV K

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C1 C16	CAP, F.T., .6.8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	2
C10 C11 C13 C17 C18 C19 C2 C21 C29 C31 C5	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	11
C22 C3 C6	CAP, FT, CER, 100PF, 20% CF104-110	4420-100PF	AER	1510-30-3101	3
C20 C4	CAP, CER, 100PF, 1KV CD108-110	CN1500	RMC	1510-10-5101	2
C7	CAP, CER, .001MFD, 1KV CD102-210	5GAD10	SPR	1510-10-1102	1
C8	CAP, G.C., .75PF CG101-175	QC-.75PF	Q-C	1510-40-0758	1
C12 C15 C9	CAP, TANT, .47MF, 50V CE113-447	935	TRW	1510-21-9470	3
C14*	CAP, G-C, 2.4PF, 10% CG101-224	QC-2.4PF	Q-C	1510-40-0249	1
C23 C25	CAP, F.T., .470PF CF101-147	FA5C-4712	A-B	1510-30-0471	2
C24 C26	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	2
C27 C30	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	2
TITLE SWP OSC, M9L		ASSEMBLY NO. 1114-00-0060 PAGE: 1			REV F
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C28	CAP, VALUE DETERMINED IN CALIBRATION	CAP, TRIM	W-I	1519-99-9999	1
C32*	CAP, G.C., .3.9PF CG101-239	QC-3.9PF	Q-C	1510-40-0399	1
C1	CAP, M.C., .47PF CG102-147	MC-.47PF	Q-C	1510-40-1478	1
CR1 CR2 CR3 CR7 CR8	DIODE DC000-005	BB141A	ITT	4889-00-0001	5
CR4 CR5	DIODE DG100-823	1N82A	S-T	4807-03-0002	2
CR6 CR9	DIODE DB000-001	HW6.8B	MSP	4801-02-0001	2
C01 C02	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2
L1 L3	CHOKE .22MH 10% LA005-R02	08NR22K	ASE	1810-03-0228	2
L10 L11 L2 L4 L5	RF CHOKE	CHOKE	W-I	1819-99-9999	5
L07 L12	TORRID, 4 TURN	LA009-004-1	HYT	1810-05-0003	2
L9	CHOKE, 1MH, 10% LA005-R10	08N10K	ASE	1810-03-0010	1
Q1 Q3 Q5	TRANS QB000-009	MPS3702	MOT	4902-03-7020	3
Q02	TRANS QB000-013	A430	APX	4902-00-4300	1
Q04 Q05 Q06 Q12	TRANS QA050-530	2N5053	APX	4901-05-0530	4
TITLE SWP OSC, M9L		ASSEMBLY NO. 1114-00-0060 PAGE: 2			REV F
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
Q7	TRANS QA050-880	2N5088	MDT	4901-05-0880	1
Q9	TRANS QA038-541	2N3854A	G-E	4901-03-8541	1
Q10 Q11 Q13	TRANS QA051-790	2N5179	RCA	4901-05-1790	3
R01	RES. C, 1/4W, 5%, 18K RC103-318	CF1/4-18K	ASE	4700-15-1802	1
R2 R27 R28	RES. C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	3
R22 R3	POT, 10K, RP129-310	360S103B	CTS	4610-00-1103	2
R30 R4	RES. C, 1/4W, 5%, 680 RC103-168	CF1/4-680	ASE	4700-15-6800	2
R19 R26 R31 R32 R38 R5 R6	RES. C, 1/4W, 10%, 4.7K RC104-247AB	CB4721	A-B	4705-16-4701	7
R33 R7	RES. C, 1/4W, 5%, 10 RC103-010	CF1/4-10	ASE	4700-15-1009	2
R8	RES. C, 1/4W, 5%, 5.6K RC103-256	CF1/4-5.6K	ASE	4700-15-5601	1
R9	POT, 20K, RP129-320	360S203B	CTS	4610-00-1203	1
R10	RES. C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1
R11	RES. C, 1/4W, 5%, 4.7 RC103-R47	CF1/4-4.7	ASE	4700-15-4708	1
WAVETEK PARTS LIST		TITLE SWP OSC, M9L ASSEMBLY NO. 1114-00-0060 PAGE: 3			REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
R12	RES, C, 1/4W, 5%, 390 RC103-139	CF1/4-390	ASE	4700-15-3900	1	
R13 R21 R34 R35 R39	RES, C, 1/4W, 5%, 100 RC103-110	CF1/4-100	ASE	4700-15-1000	5	
R14 R17 R36 R37	RES, C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	4	
R15	RES, C, 1/4W, 5%, 1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	1	
R16	RES, C, 1/4W, 5%, 27K RC103-327	CF1/4-27K	ASE	4700-15-2702	1	
R18 R20 R40	RES, C, 1/4W, 5%, 47 RC103-047	CF1/4-47	ASE	4700-15-4709	3	
R23	POT, 20K RP124-320	WA2G032S-203MA	A-B	4610-10-7203	1	
R24	RES, C, 1/4W, 5%, 7.5K RC103-275	CF1/4-7.5K	ASE	4700-15-7501	1	
R25	RES, C, 1/4W, 5%, 33K RC103-333	CF1/4-33K	ASE	4700-15-3302	1	
R29	RES, C, 1/4W, 5%, 2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	1	
R41	RES, C, 1/4W, 5%, 150	CF1/4-150	ASE	4700-15-1500	1	
R42	RES, C, 1/4W, 5%, 22	CF1/4-22	ASE	4700-15-2200	1	
18	RES, C, 1/4W, 5%, 4.7K	CF1/4-4.7K	ASE	4700-15-4701	2	
WAVETEK PARTS LIST		TITLE SWP OSC, M9L			ASSEMBLY NO. 1114-00-0060 PAGE: 4	REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
C1 C14 C5 C6	CAP, TANT, .47MF, 50V CE113-447	935	TRW	1510-21-9470	4	
C15 C2 C3	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	3	
C29 C31 C33 C4	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	4	
C11 C12 C25 C7	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	4	
C8	CAP, CER, 15PF, 1KV CD101-015	10TCC-G15	SPR	1510-10-0150	1	
C9	CAP, CER, 4.7PF, 1KV CD101-R47	10TCC-V47	SPR	1510-10-0479	1	
C10	CAP, CER, 10PF, 1KV CD101-010	10TCC-G10	SPR	1510-10-0100	1	
C13	CAP, FT, CER, 100PF, 20% CF104-110	4420-100PF	AER	1510-30-3101	1	
C16 C28 C30 C32	CAP, F. T. , 470PF CF101-147	FA5C-4712	A-B	1510-30-0471	4	
C17 C20	CAP, CER, 200PF, 1KV CD102-120	5GA-T20	SPR	1510-10-1201	2	
C18 C19 C27 C34	CAP, F. T. , 6.8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	4	
WAVETEK PARTS LIST		TITLE OUTPUT AMP, M10GA			ASSEMBLY NO. 1114-00-0032 PAGE: 1	REV H

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
C21	CAP, CER, .001MFD, 1KV CD102-210	5GAD10	SPR	1510-10-1102	1	
C22	CAP, CER, 360PF, 1KV CD102-136	60U361M	MDC	1510-10-1361	1	
C23	CAP, CER, .005MF, 100V	TG-D50	SPR	1510-10-2502	1	
C24	CAP, CER, 47PF, 1KV CD104-047	60U2J470J	MDC	1510-10-3470	1	
C26	CAP, CER, 120PF, 1KV CD102-112	60U121M	MDC	1510-10-1121	1	
CR1 CR2 CR3	DIODE DP000-050	5082-3080	H-P	4805-02-0002	3	
CR4 CR5	DIODE DC000-008	BB205	APX	4803-02-0004	2	
CR6 CR7	DIODE DC000-005	BB141A	ITT	4889-00-0001	2	
CR8	DIODE DG000-007	5082-2800	H-P	4809-02-0001	1	
CR9	DIODE DR000-001	1N4004	P-C	4806-01-4004	1	
J1	CONN JF000-005	37JR116-1	S-C	2110-03-0002	1	
J2	CONN JF000-004	27-21	APL	2110-03-0001	1	
L1 L16 L2 L7	RF CHOKE	CHOKE	W-I	1819-99-9999	4	
L03 L04 L09 L12 L13 L14	TORRID, 10 TURN	LA009-010-1	HYT	1810-05-0004	6	
WAVETEK PARTS LIST		TITLE OUTPUT AMP, M10GA			ASSEMBLY NO. 1114-00-0032 PAGE: 2	REV H

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
L05 L06 L08 L10 L11	TORRID, 4 TURN	LA009-004-1	HYT	1810-05-0003	5
L15	CHOKE, 10MILH, 10% LA004-310	15S103K	ASE	1810-02-1001	1
Q1 Q2	TRANS QA050-530	2N5053	APX	4901-05-0530	2
Q3 Q5 Q6	TRANS QB000-018	SD1006	SSS	4902-01-0060	3
Q4	TRANS QB000-013	A430	APX	4902-00-4300	1
Q7	TRANS QA054-580	2N545B	MDT	4901-05-4580	1
Q8	TRANS QB000-010	TD101	SPR	4902-00-1010	1
Q10 Q9	TRANS QB000-009	MPS3702	MDT	4902-03-7020	2
R1 R26 R4	RES. C, 1/4W, 5%, 47 RC103-047	CF1/4-47	ASE	4700-15-4709	3
R2	RES. C, 1/4W, 5%, 330 RC103-133	CF1/4-330	ASE	4700-15-3300	1
R3 R33 R45	RES. C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	3
R5	RES. C, 1/4W, 5%, 150 RC103-115	CF1/4-150	ASE	4700-15-1500	1
R14 R17 R22 R25 R6	RES. C, 1/4W, 5%, 10 RC103-010	CF1/4-10	ASE	4700-15-1009	5
R52 R7	RES. C, 1/4W, 5%, 100 RC103-110	CF1/4-100	ASE	4700-15-1000	2
WAVETEK PARTS LIST		TITLE OUTPUT AMP, M10GA ASSEMBLY NO. 1114-00-0032 PAGE: 3			REV H

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
R8	RES. C, 1/4W, 5%, 820 RC103-182	CF1/4-820	ASE	4700-15-8200	1	
R49 R51 R9	RES. C, 1/4W, 5%, 220 RC103-122	CF1/4-220	ASE	4700-15-2200	3	
R10	RES. C, 1/4W, 5%, 560 RC103-156	CF1/4-560	ASE	4700-15-5600	1	
R11	RES. C, 1/4W, 5%, 56 RC103-056	CF1/4-56	ASE	4700-15-5609	1	
R12 R21	RES. C, 1/4, 5%, 27 RC103-027	CF1/4-27	ASE	4700-15-2709	2	
R13	RES. C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	1	
R15 R19 R20	RES. C, 1/4W, 5%, 82 RC103-082	CF1/4-82	ASE	4700-15-8209	3	
R16	RES. C, 1/4W, 5%, 1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	1	
R18	RES. C, 1/4W, 5%, 22 RC103-022	CF1/4-22	ASE	4700-15-2209	1	
R23	RES. C, 1/2W, 5%, 360 W-I/RC105-136AB	EB3615	A-B	4705-25-3600	1	
R24	RES. C, 1W, 5%, 150 RC107-115	QB1515	A-B	4700-35-1500	1	
WAVETEK PARTS LIST		TITLE OUTPUT AMP, M10GA			ASSEMBLY NO. 1114-00-0032 PAGE: 4	REV H

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R27	RES, C, 1/4W, 5%, 39K RC103-339	CF1/4-39K	ASE	4700-15-3902	1
R28 R30	RES, C, 1/4W, 5%, 33K RC103-333	CF1/4-33K	ASE	4700-15-3302	2
R29	RES, C, 1W, 5%, 120 RC107-112	GB1215	A-B	4700-35-1200	1
R31	RES, C, 1/4W, 5%, 75 RC103-075	CR1/4-75	ASE	4700-15-7509	1
R32	RES, C, 1/4W, 10%, 82 RC104-082AB	CB8201	A-B	4705-16-8209	1
R34 R38 R46	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	3
R35	RES, C, 1/4W, 5%, 1M RC103-510	CF1/4-1M	ASE	4700-15-1004	1
R36	RES, C, 1/4W, 5%, 2.2M RC103-522	CF1/4-2.2M	ASE	4700-15-2204	1
R37 R39	POT, 20K RP124-320	WA26032S-203MA	A-B	4610-10-7203	2
R40	RES, C, 1/4W, 5%, 270K RC103-427	CF1/4-270K	ASE	4700-15-2703	1
R41	RES, C, 1/4W, 5%, 1.2K RC103-212	CF1/4-1.2K	ASE	4700-15-1201	1
TITLE OUTPUT AMP, M10GA		ASSEMBLY NO. 1114-00-0032 PAGE: 5			REV H
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R42	RES, C, 1/4W, 5%, 390K RC103-439	CF1/4-390K	ASE	4700-15-3903	1
R43	RES, C, 1/4W, 5%, 2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	1
R44 R50	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	2
R47	RES, C, 1/4W, 5%, 820K RC103-482	CF1/4-820K	ASE	4700-15-8203	1
R48	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1
NONE	RES, C, 1/4W, 10%, 100 RC104-110AB	CB1001	A-B	4705-16-1000	2

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	OUTPUT AMP, M10GA	1114-00-0032	H
		PAGE: 6	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C08 C09 C10 C11 C12	CAP, CER, .001MFD, 1KV CD102-210	5GAD10	SPR	1510-10-1102	6
C02	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	1
C03 C04 C05 C06 C07	CAP, VAR, 3.5-13PF250V CV101-013	7S-TRIAD-02-3.5-13PF	STR	1510-70-0130	5
C13 C29	CAP, F.T., 6.8PF CF102-R68	54-794-010-6892	SPEC	1510-30-1689	2
C14 C15 C16 C17 C18	CAP, CER, 200PF, 1KV CD102-120	5GA-T20	SPR	1510-10-1201	5
C19 C22	CAP, CER, .05MF, 100V CD103-350	TG-S50	SPR	1510-10-2503	2
C20 C21 C24 C25 C26 C27 C28	CAP, CER, F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	7
C23	CAP, CER, 120PF, 1KV CD102-112	60U121M	MDC	1510-10-1121	1
CR01 CR02 CR03 CR04 CR05	DIODE DG000-009	5082-2835	H-P	4809-02-0002	5
CR06 CR07 CR08 CR09 CR10 CR11 CR12 CR13	DIODE DG109-140	1N4148	T-I	4807-01-0914	8
IC01 IC02 IC03	IC, IC000-005	RC4558NB	RAY	7000-14-5800	3
J01	CONN JF000-005	37JR116-1	S-C	2110-03-0002	1
WAVETEK PARTS LIST		TITLE RF MKR, M13J-1			REV
		ASSEMBLY NO. 1114-00-0318 PAGE: 1			

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
Q01 Q09	TRANS QA050-530	2N5053	APX	4901-05-0530	2
Q02 Q03 Q04 Q05 Q06	TRANS QB000-009	MPS3702	NAT	4902-03-7020	5
Q08	TRANS QA038-541	2N3854A	SPR	4901-03-8541	1
R01	POT, 1K	WA26032S-102MA	A-B	4610-10-7102	1
R02	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1
R03 R05 R06 R07 R08 R09	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	6
R04	RES, C, 1/4W, 5%, 56 RC103-056	CF1/4-56	ASE	4700-15-5609	1
R10 R11 R12 R13 R14	RES, C, 1/4W, 5%, 270 RC103-127	CF1/4-270	ASE	4700-15-2700	5
R15 R34	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	2
R16	RES, C, 1/4W, 5%, 1.5M RC103-515	CF1/4-1.5M	ASE	4700-15-1504	1
R17 R18 R19 R20 R21	RES, C, 1/4W, 5%, 360K RC103-436	CF1/4-360K	ASE	4700-15-3603	5
R22 R23 R24 R25 R26	RES, C, 1/4W, 5%, 51K RC103-351	CF1/4-51K	ASE	4700-15-5102	5
R28 R29 R30 R31 R32 R36 R47 R48 R49 R50 R51	RES, C, 1/4W, 5%, 22K RC103-322	CF1/422K	ASE	4700-15-2202	11
WAVETEK PARTS LIST		TITLE RF MKR, M13J-1			REV
		ASSEMBLY NO. 1114-00-0318 PAGE: 2			

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
R35	RES, C, 1/4W, 5%, 56K RC103-356	CF1/4-56K	ASE	4700-15-5602	1	
R37	RES, C, 1/4W, 5%, 1M RC103-510	CF1/4-1M	ASE	4700-15-1004	1	
R38 R39 R40 R41 R42	RES, C, 1/4W, 5%, 5.6K RC103-256	CF1/4-5.6K	ASE	4700-15-5601	5	
R43	RES, C, 1/4W, 5%, 3.3K RC103-233	CF1/4-3.3K	ASE	4700-15-3301	1	
R44	RES, C, 1/4W, 5%, 2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	1	
R45	RES, C, 1/4W, 5%, 820 RC103-182	CF1/4-820	ASE	4700-15-8200	1	
R46	RES, C, 1/4W, 5%, 10 RC103-010	CF1/4-10	ASE	4700-15-1009	1	
T01	RF XFMR FROM: 1813-00-0007	1210-40-0017	W-I	1210-40-0017	1	
WAVETEK PARTS LIST		TITLE RF MKR, M13J-1			ASSEMBLY NO. 1114-00-0318 PAGE: 3	REV

SECTION 6

SCHEMATICS

6.1 INTRODUCTION

This section contains all schematics for the instrument. A schematic index is given in Section 6.4.

6.2 SCHEMATIC NOTES

The following notes and abbreviations pertain to all schematics. Additional notes pertaining to specific schematics

are included on each schematic if required.

All values are shown in the following units unless otherwise specified.

Components	Units
Resistor	ohms
Capacitor	picofarads
Inductor	microhenries



Denotes DC voltage reading in volts unless otherwise specified.



Denotes high impedance crystal detector reading in volts unless otherwise specified.



Denotes 50 ohm crystal detector reading in volts unless otherwise specified.



Signal or voltage source.



Connects to indicated signal or voltage source.



Arrow indicates clockwise rotation of wiper.



Coaxial jack



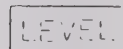
Coaxial plug



Coaxial cable



Factory adjusted part.



Denotes a front-panel device.



Denotes a rear-panel device.



Denotes a PC board adjustment or accessible module adjustment.



Denotes an internal module adjustment not accessible without removing module cover.

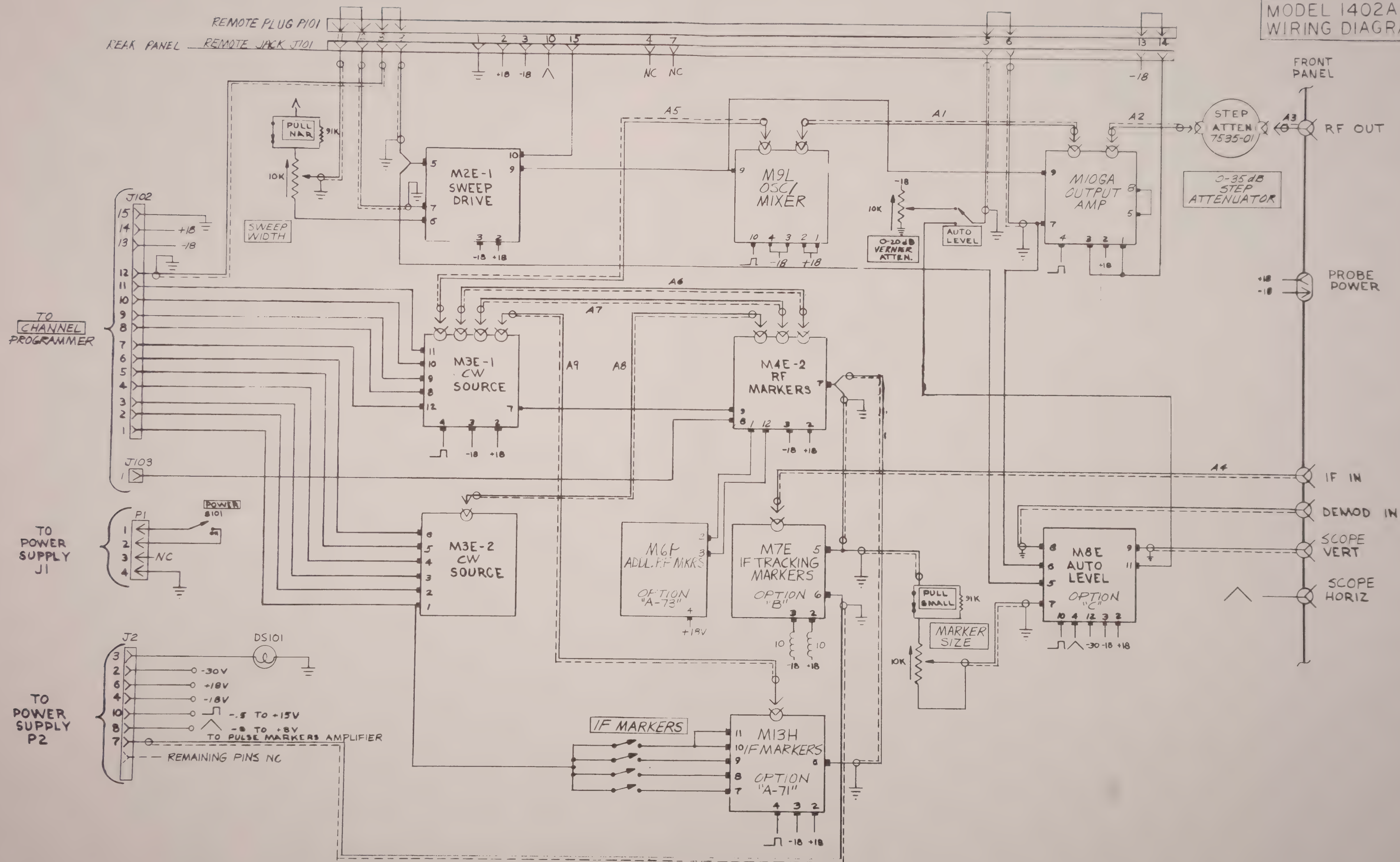
6.3 ABBREVIATION CODE

A	Assembly	IF	intermediate frequency	Ω	ohm
A	ampere	J	jack	OC	opto-coupler
AC	alternating current	K	relay	P	plug
C	capacitor	kHz	kilohertz	pp	peak-to-peak
CR	diode	k Ω	kilohm	pF	picofarad
CW	continuous wave	kV	kilovolt	Q	transistor
cw	clockwise	kW	kilowatt	R	resistor
dB	decibel	L	inductor	RF	radio frequency
dBm	decibel referred to 1 mW	MHz	megahertz	RMS	root-mean-square
dBmV	decibel referred to 1 mV	M Ω	megohm	R.P.	rear panel
DC	direct current	μ F	microfarad	S	switch
DS	indicating device, lamp	μ A	microampere	T	transformer
F	farad	μ H	microhenry	T.P.	test point
F.P.	front panel	M	meter	V	volt
H	henry	mA	milliampere	VA	voltampere
Har	harmonic	mH	millihenry	W	watt
Hz	hertz	mV	millivolt	X	crystal
IC	integrated circuit	mW	milliwatt		

6.4 SCHEMATIC INDEX

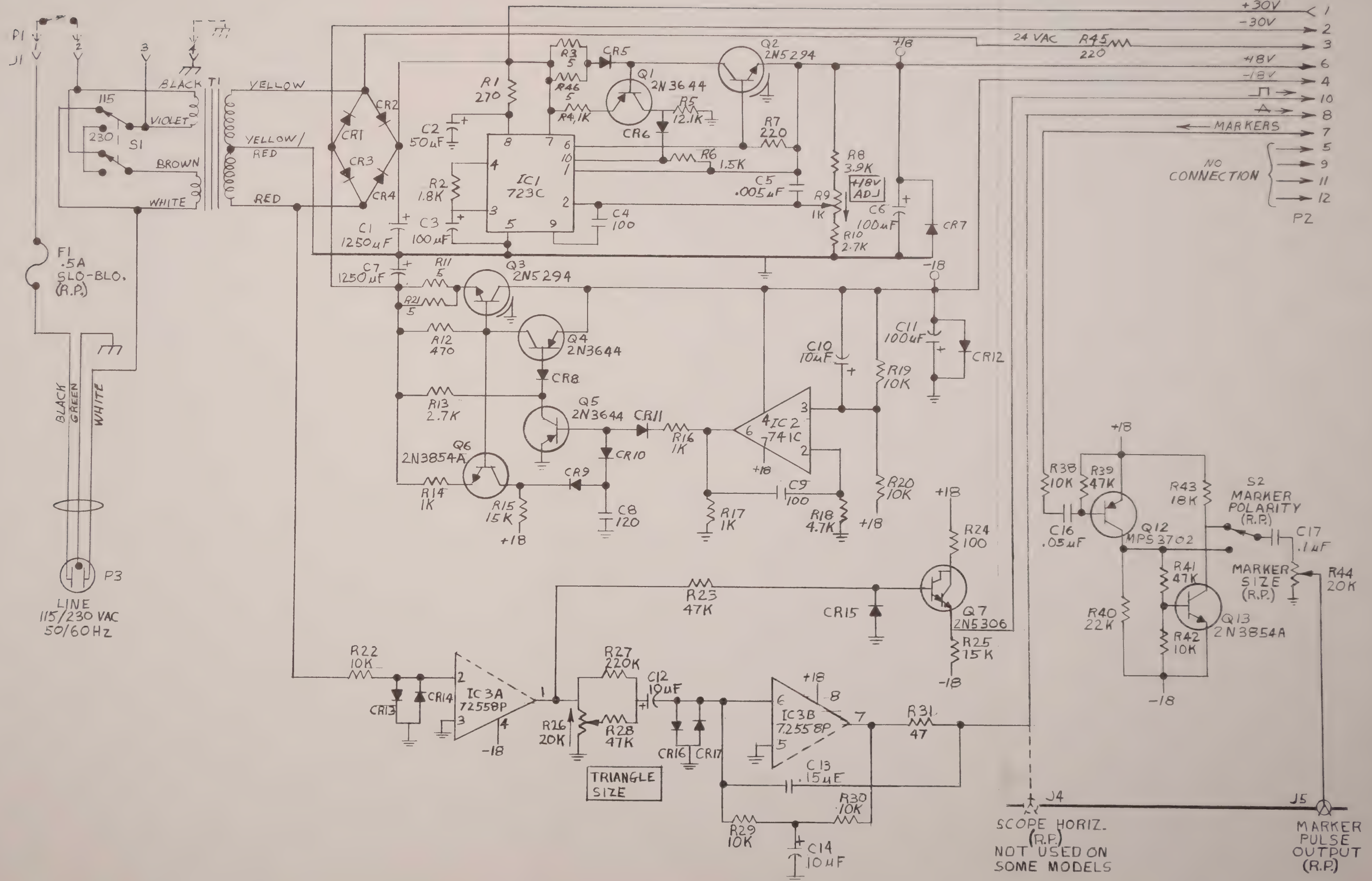
<u>SCH. NO</u>	<u>ASSY.</u>	<u>NAME</u>
1	1402A	WIRING DIAGRAM
2	PS7	POWER SUPPLY
3	RS07	CHANNEL SWITCH
4	M2E-1	SWEEP DRIVE
5	M3E-1	CW SOURCE
6	M3E-2	CW SOURCE
7	M4E-2	PULSE MARKERS
8	M6P	ADDITIONAL RF MARKERS
9	M7E	IF TRACKING
10	M8E	AUTO LEVEL
11	M9L	SWEEP OSCILLATOR
12	M10GA	OUTPUT AMPLIFIER
13	M13J-1	IF MARKERS

MODEL 1402A WIRING DIAGRAM

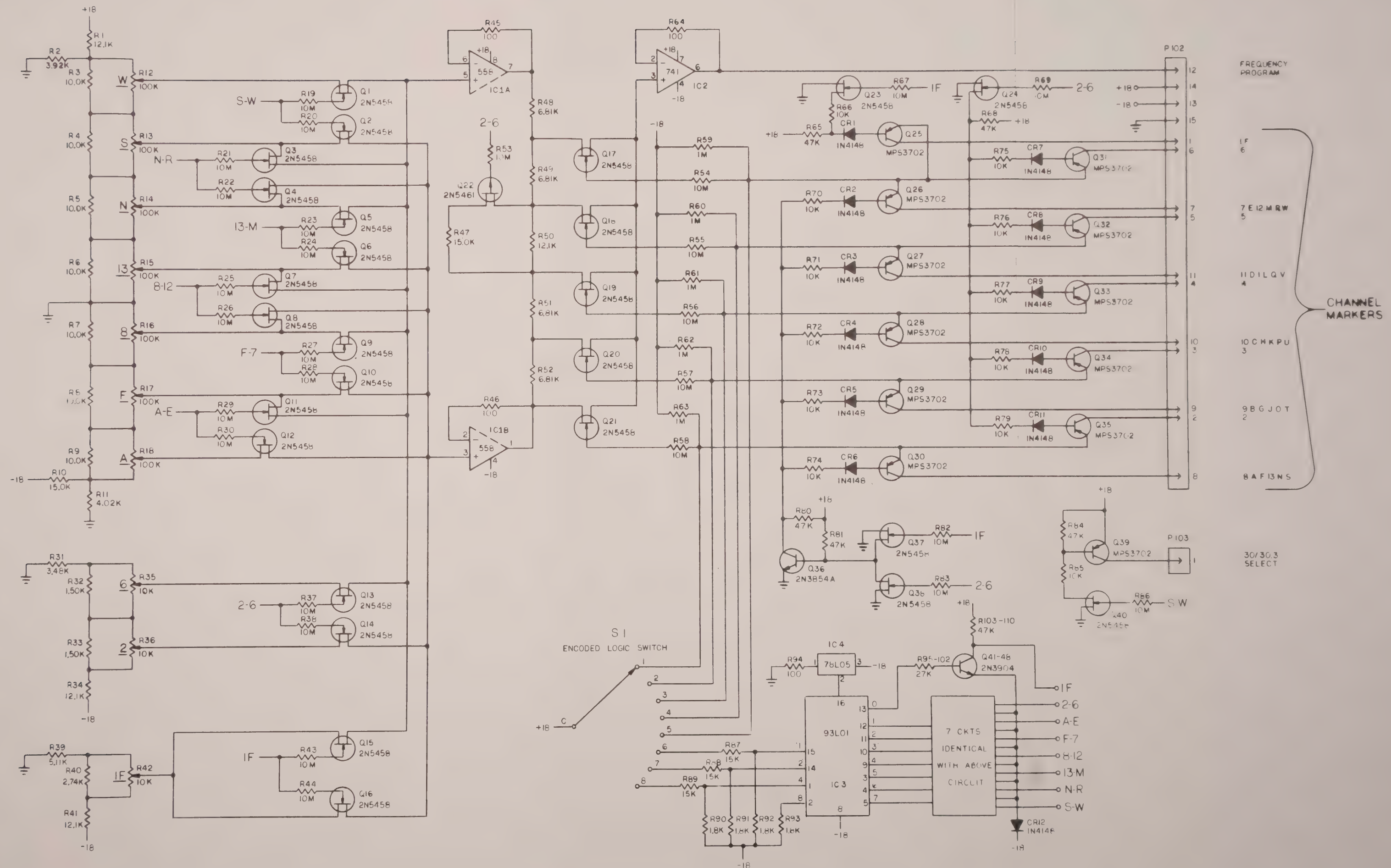


PS7 POWER SUPPLY

REV. 1

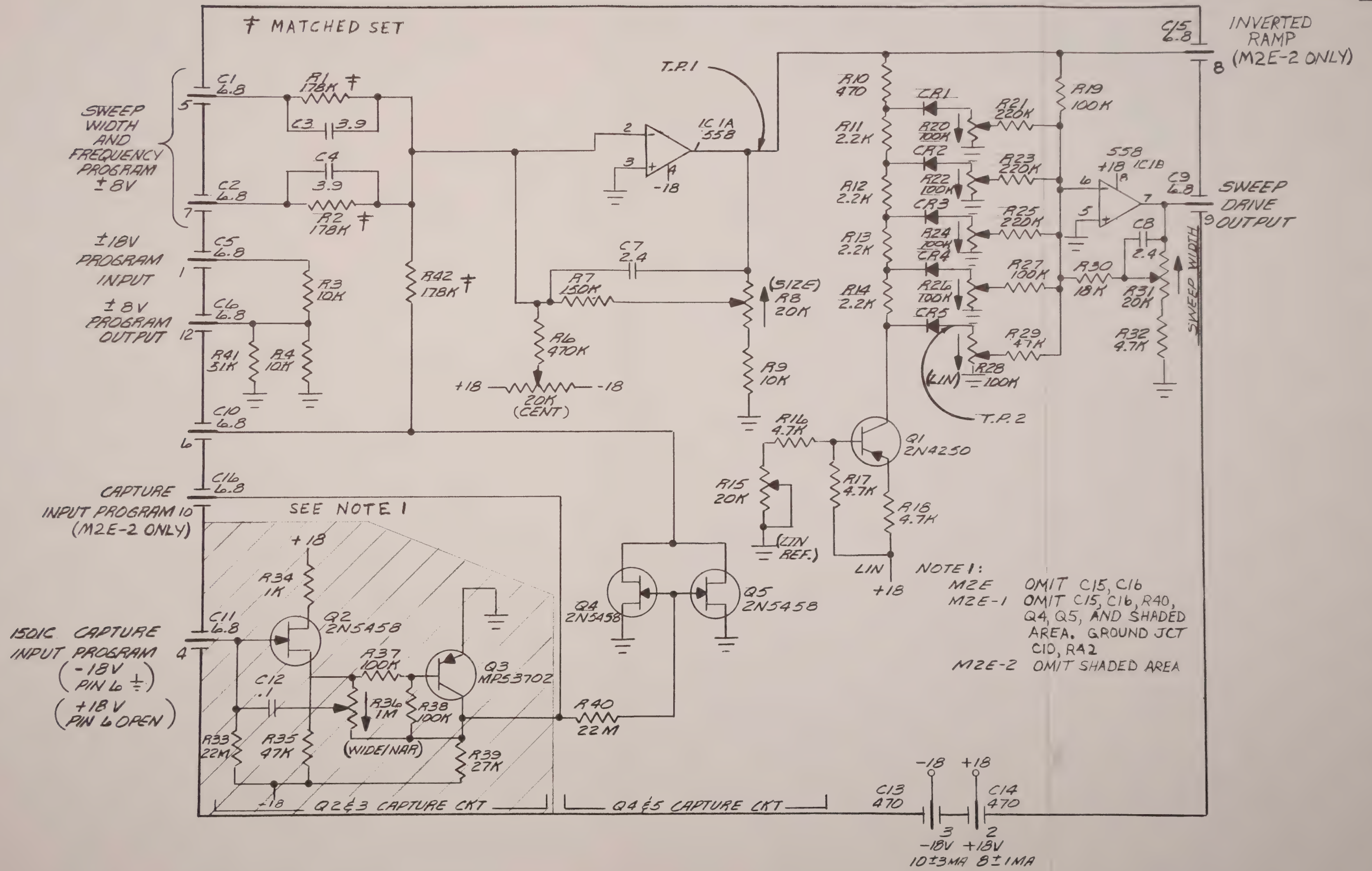


RS-07 SERIES
36 CHANNEL
PROGRAMMER



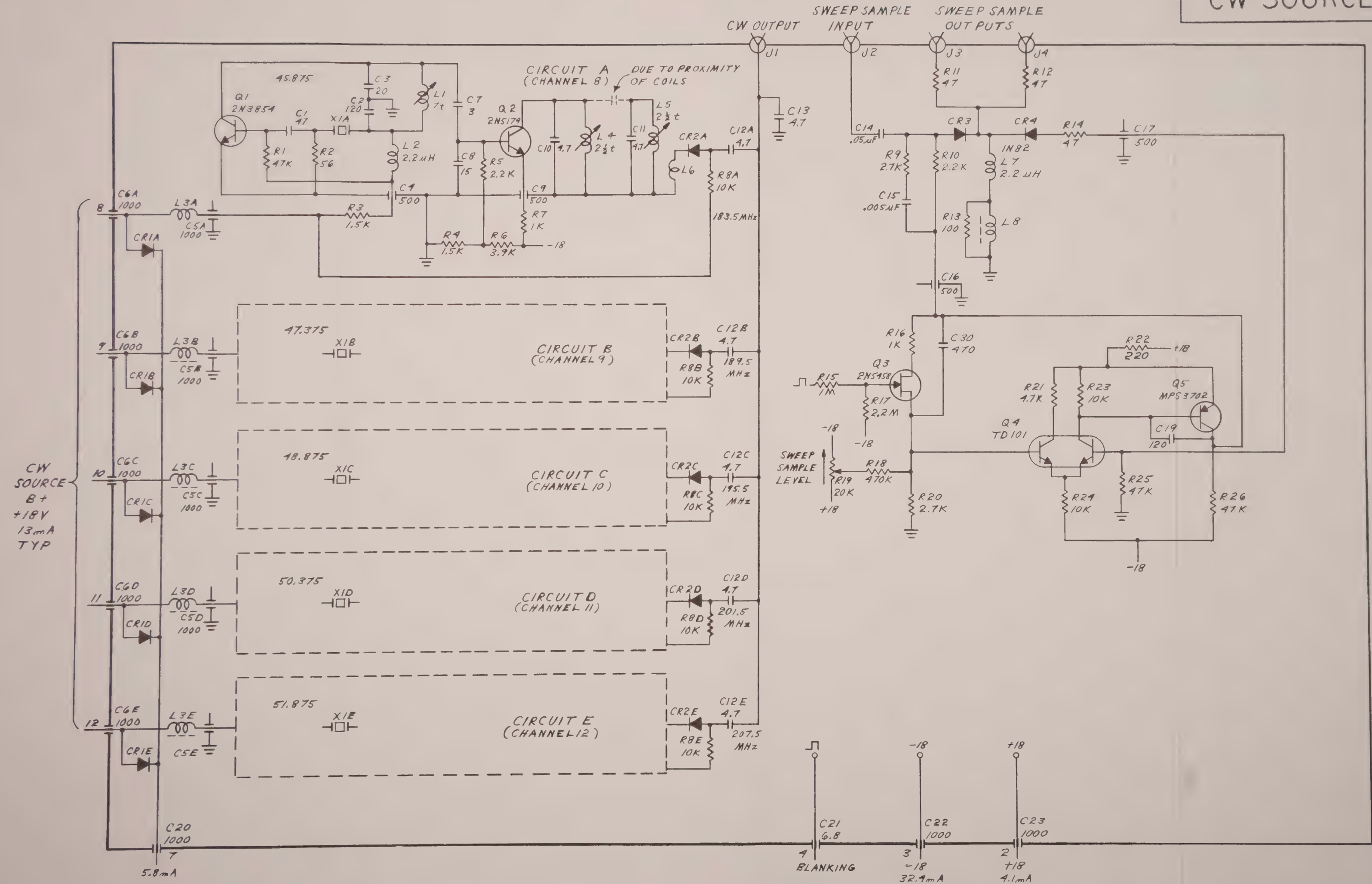
M2E, M2E-1, M2E-2 SWEEP DRIVE

REV. C

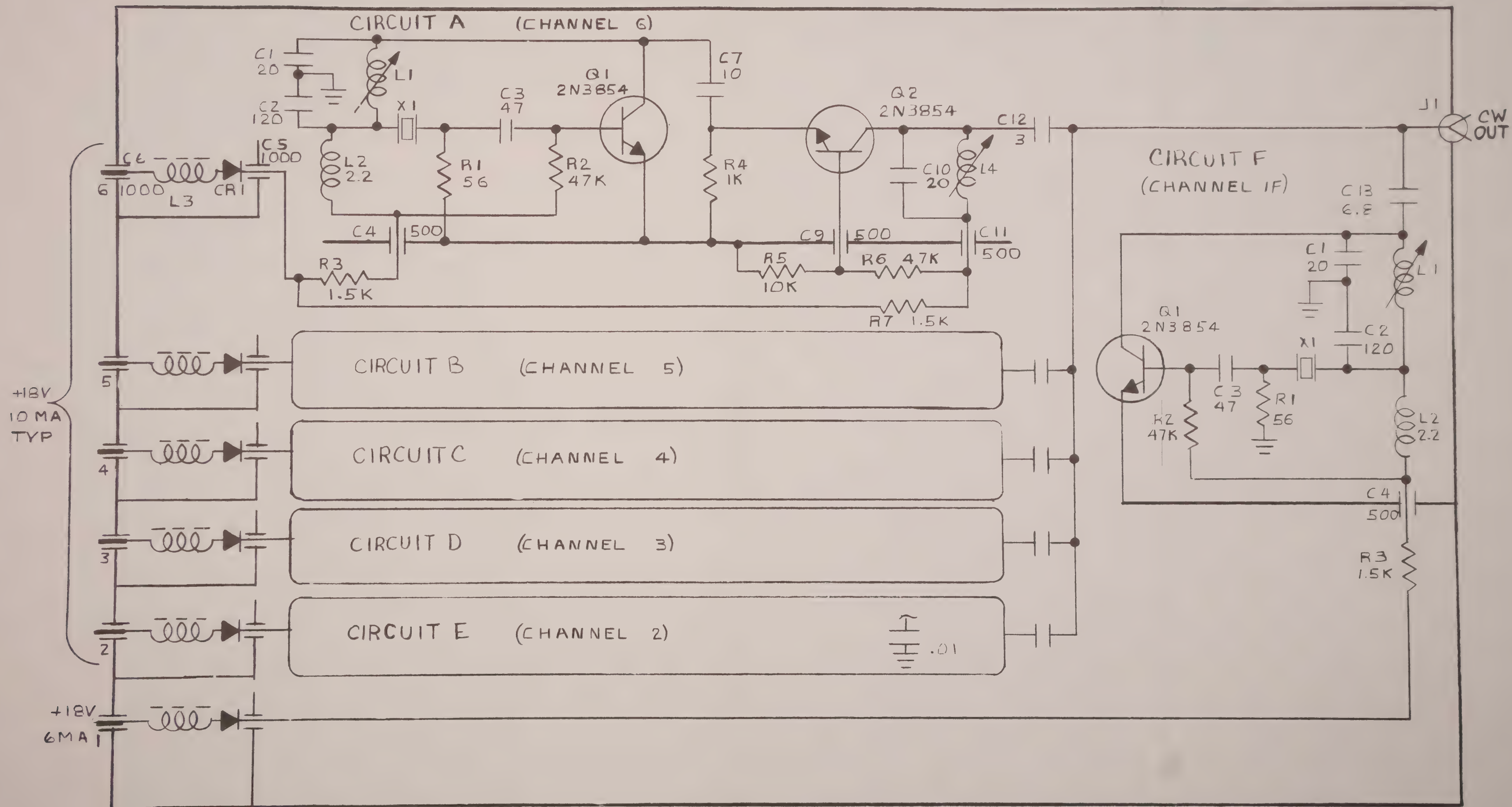


M3E-1 CW SOURCE

REV. —



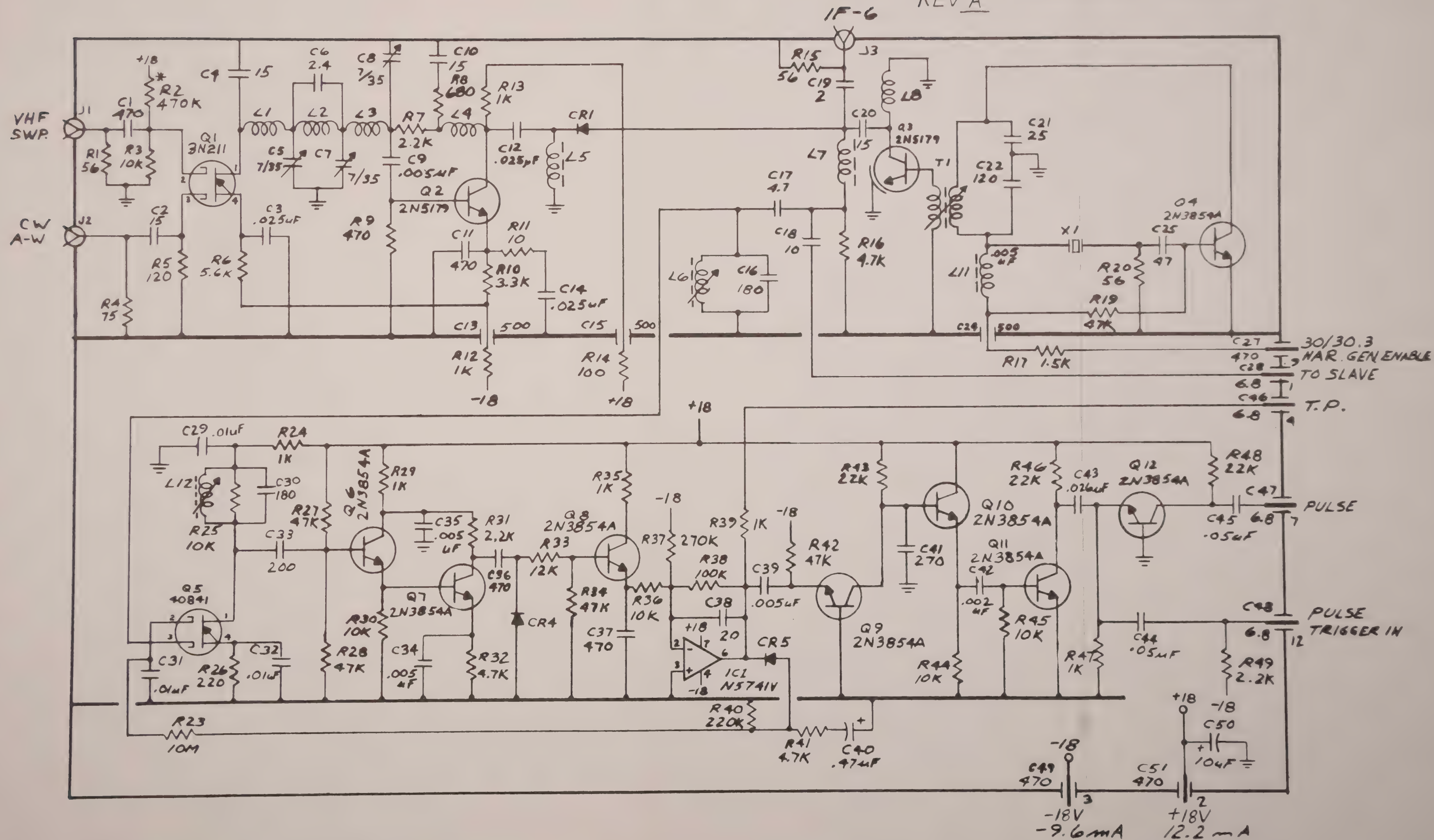
M3E-2
CW SOURCE



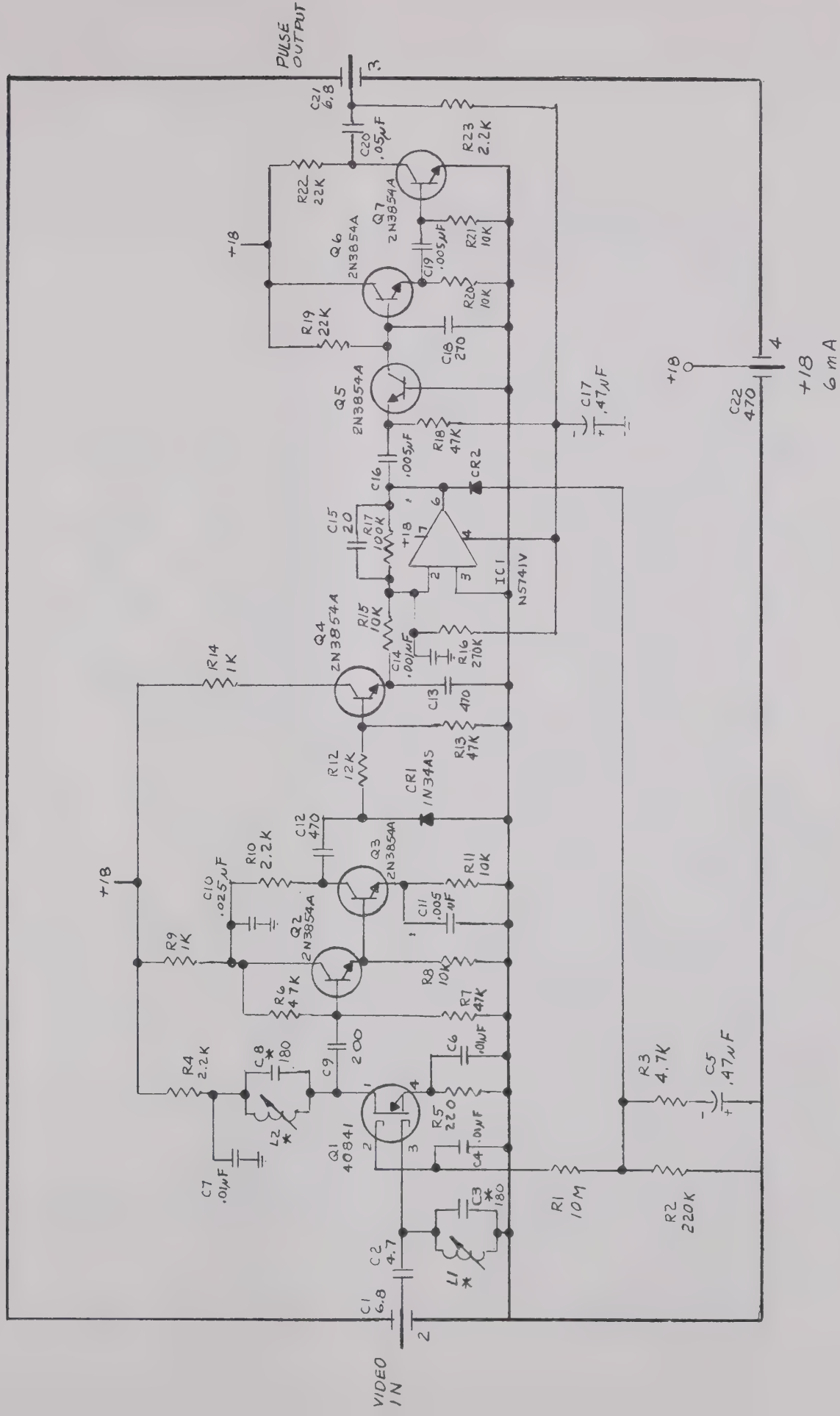
NOTE: R7 ON CIRCUITS B,C ONLY

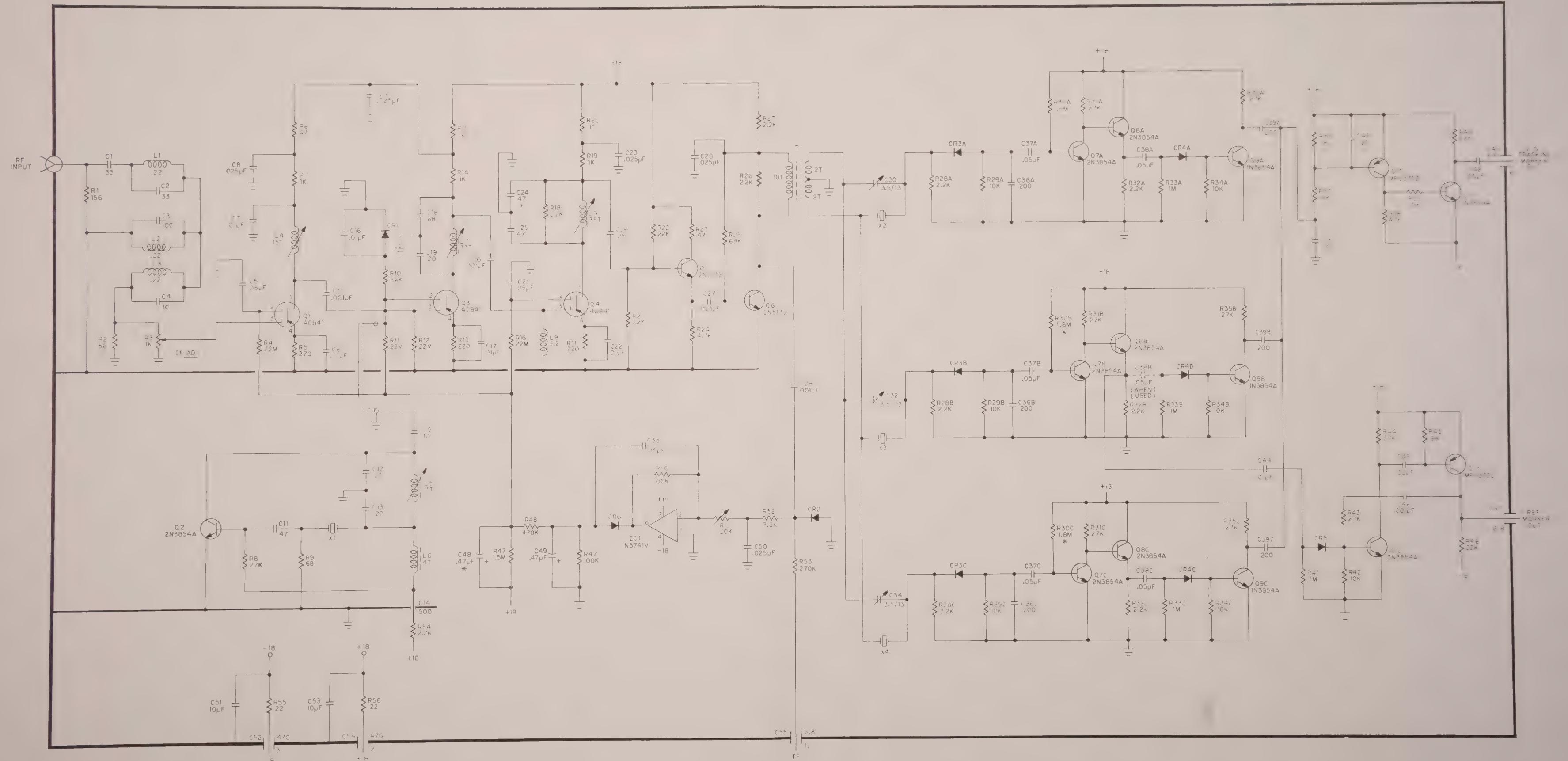
M4E-2 PULSE MARKER

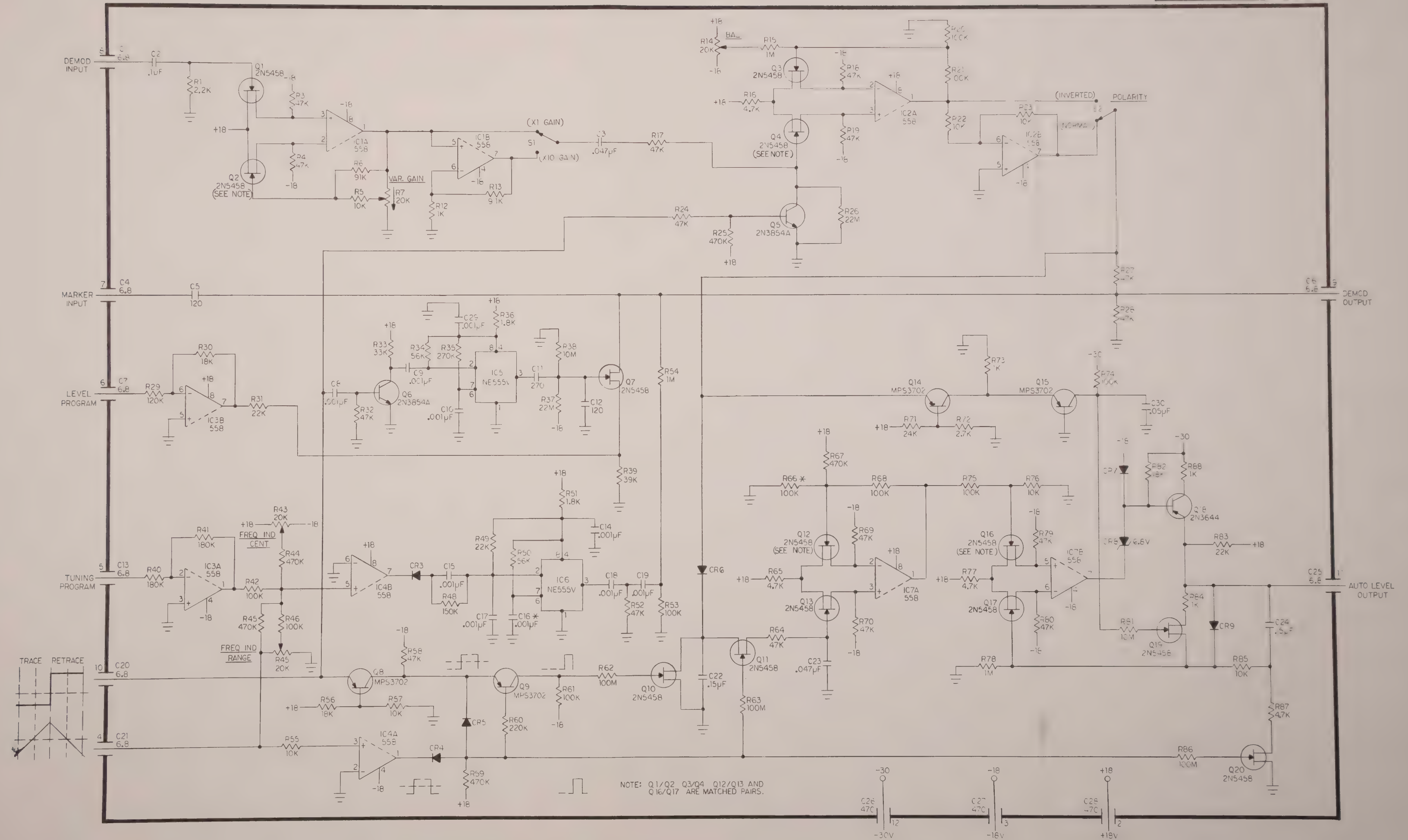
REV A



M6P ADDITIONAL RF MARKERS

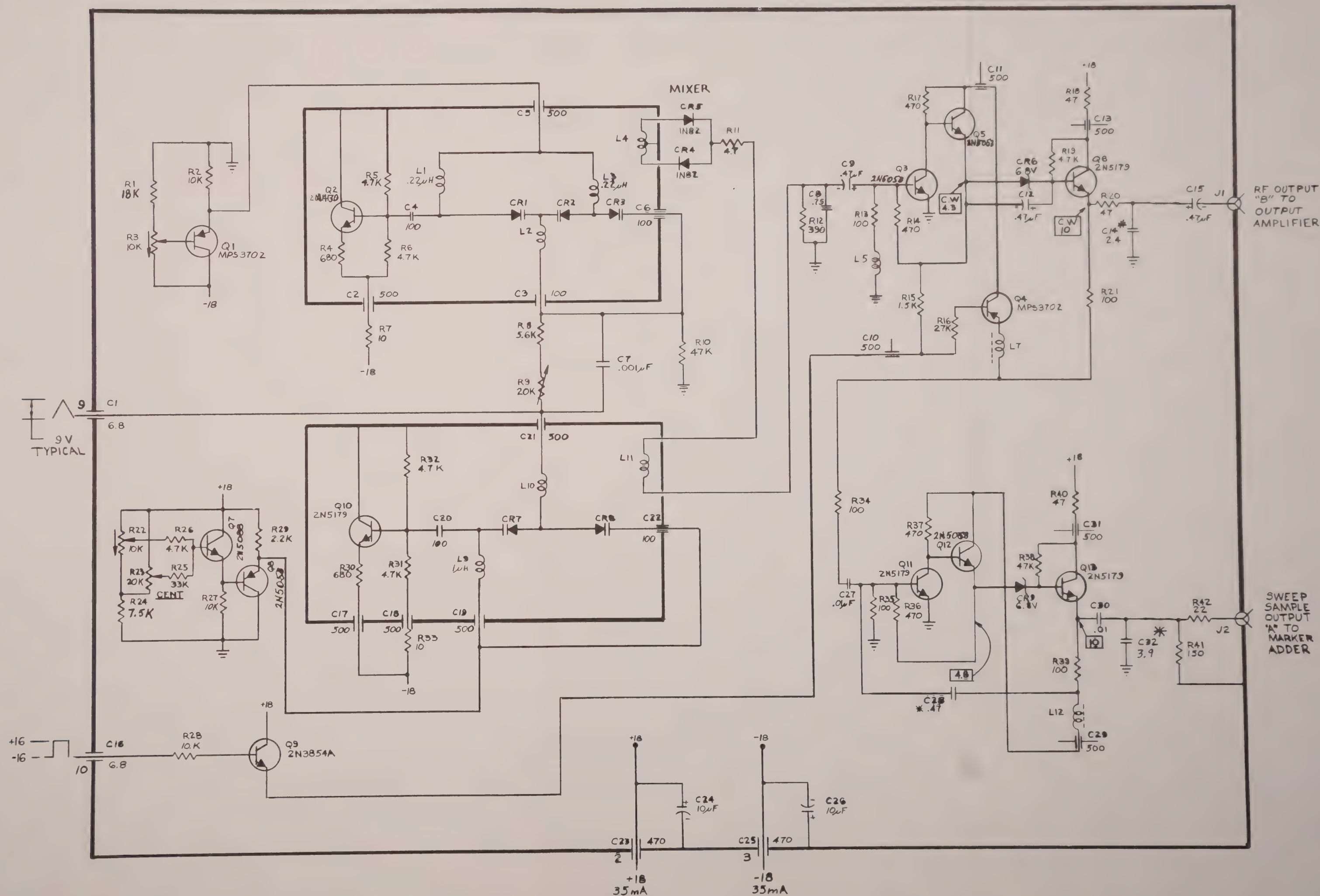






M9L OSC/MIXER

REV 6



MIOF 0-300 MHz
MIOG 0-500 MHz

MIOF & MIOG OUTPUT AMP

REV G

